DOCUMENT RESUME

ED 099 493 95 CE 002 570

AUTHOR	Mortensen, James H.
TITLE	Occupational Preparation in the Natural Resources: A Suggested High School Curriculum Guide.
INSTITUTION	Pennsylvania State Univ., University Park. Dept. of Agricultural Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	73
GRANT	OEG-0-71-4432-357
NOTE	75p.; Illustrations will reproduce poorly. For related documents in the series, see CE 002 569-572
AVAILABLE FROM	Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402
EDRS PRICE	MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS	*Career Education; Career Opportunities; Curriculum Development; *Curriculum Guides; Employment Opportunities; Employment Qualifications; *Job Training; *Natural Resources; Occupational Information; Post Secondary Education; *Program Development; Program Guides; Secondary Education; Units of Study (Subject Fields)
IDENTIFIERS	Pennsylvania

ABSTRACT

This curriculum guide was developed to provide a model plan to help public high schools and area vocational-technical schools to initiate, or evaluate and improve, natural resource occupational preparation programs. It offers a curriculum plan which can be modified to meet particular needs and objectives which are career education oriented. This guide provides unit outlines on air, fish, forestry, land use planning, minerals and mineral fuels, range, recreation, soil, water, and wildlife with suggested behavioral objectives, learning activities, and references; a sequence of career education efforts; discussion of occupational opportunities, faculty, student services, and the library and its use. Briefly discussed are the facilities and equipment needed. Appended are three lists of text and reference books, audiovisual aids, and professional and technical societies and organizations concerned with natural resources. (Author/BP)

BEST COPY AVAILABLE

DISCRIMINATION PROHIBITED - Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance." Therefore, the Vocational Education program, like every program or activity receiving financial assistance from the Department of Health, Education, and Welfare, must be operated in compliance with this law.

Titles of all curriculum materials resulting from the project, "Career Education in the Natural Resources," grant No. OEG-0-71-4432 (357) are listed below.

Natural Resources and Career Awareness
A Teacher's Guide for Grades K-6

Exploring Occupations in the Natural Resources
A Student Resource Guide for the Middle School

Occupational Preparation in the Natural Resources
A Suggested High School Curriculum Guide

Natural Resources Technologies
A Suggested Post High School Program Development Guide

(This page was retyped at the ERIC Clearinghouse in Career Education due to the non-reproducibility of the original.)

ED 057495

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

OCCUPATIONAL PREPARATION IN THE NATURAL RESOURCES

A Suggested High School Curriculum Guide

CE 002 570

"The project presented or reported herein was performed Pursuant to a grant from the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred."

Developed and disseminated pursuant to a grant
from the U.S. Office of Education
under Part I – Curriculum Development in Vocational and Technical Education,
Vocational Education Amendments of 1968, Public Law 90-576
by
Department of Agricultural Education
The Pennsylvania State University
University Park, Pennsylvania
1973

For Sale by the Superintendent of Documents,
U.S. Covernment Printing Office
Washington, DC 20402

FOREWORD

Career education is a comprehensive, systematic, and cohesive plan of instruction that provides each student the opportunity to plan and prepare for a meaningful and satisfying role as a working member of society. Occupational clusters, representative of the entire world of work and around which a career education can be designed, were identified by the U.S. Office of Education. The 15 occupational clusters are:

- business and office
- marketing and distribution
- communications and media
- construction
- manufacturing
- transportation
- agribusiness and natural resources
- consumer and homemaking-related
- environmental control
- public services
- health
- hospitality and recreation
- personal service
- fine arts and humanities
- marine science

This suggested guide is one of four publications developed by the Department of Agricultural Education, College of Agriculture, The Pennsylvania State University, as a result of a project entitled "Career Education in the Natural Resources." The project was funded under a grant from the Division of Vocational and Technical Education, Office of Education, U.S. Department of Health, Education, and Welfare.

This project grew out of a need for materials offering strategies for implementing career development programs in the field of natural resources, a part of one occupational cluster area. Although there was an abundance of information concerning vocational development theories, there was an apparent shortage of materials offering strategies for implementing these theories into operational programs. This void was causing considerable frustration to practitioners who were attempting to design and implement plans for career education.

The purposes of the overall project were: (1) to develop appropriate curriculum guides in the natural resources suggesting a sequentially-developed education program offering career awareness, career exploration, and job preparation, (2) to acquaint educational leadership in all states with the curriculum materials resulting from this project and promote their use, and (3) to disseminate in the states, copies of the curriculum materials produced in the project.

Regional Workshops were held during May and June, 1973 in nine of the Regional Offices of the U.S. Office of Education in the following cities: Boston, Philadelphia, Atlanta, Chicago, Dallas, Kansas City, Denver, San Francisco, and Seattle. These meetings were attended by more than 300 classroom teachers, guidance counselors, school administrators, teacher educators, and state education department personnel, who were acquainted with the outcomes of the project, reviewed the guide, and were instructed in its effective use and implementation in a local program. Participants made recommendations for improving the guide and for the purpose of meeting the wide variations in needs and practices across the country. These recommendations are reflected in this final document.

Occupational preparation programs at the secondary level are designed to assist the student in converting his occupational preferences into reality, (Figure 1). Specific objectives include helping the student to:

1. Develop plans for implementing his occupational preference, whether it be entering work or continuing on for further education or training.
2. Execute these plans by appropriate course work and job experience.
3. Obtain entry level job skills and/or entrance into further education or training.

The guidance program as well as the curriculum, must receive special attention. Students need to be reminded of the necessity to master certain curricular experiences in order to be qualified for employment. Those planning formal education beyond high school must be made aware of the requirements for entering such programs.

Other curriculum materials resulting from this project are:

Natural Resources and Career Awareness
A Teacher's Guide for Grades K-6

Exploring Occupations in the Natural Resources
A Student Resource Guide for the Middle School

Natural Resources Technologies
A Suggested Post High School Program Development Guide

Dr. David R. McClay
Professor and Head
Department of Agricultural Education
The Pennsylvania State University

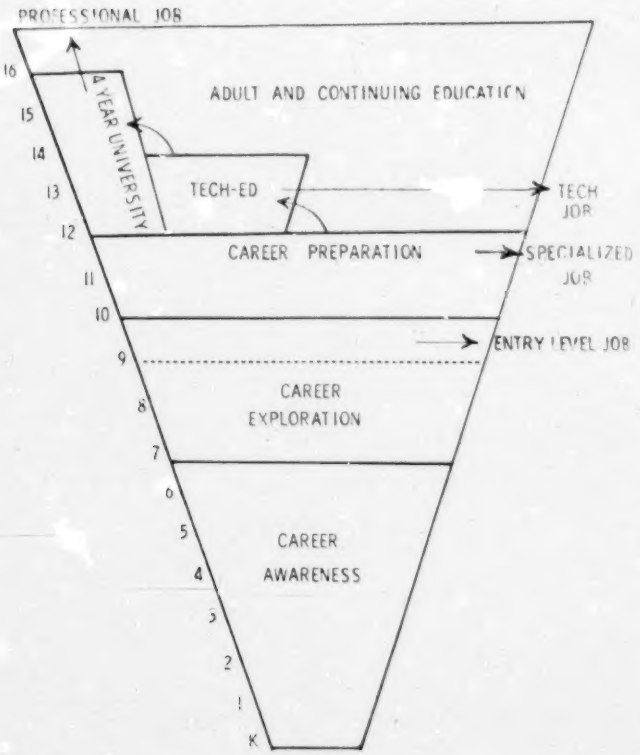

Figure 1 – Career Education. From U.S. Department of Health, Education, and Welfare, Office of Education. *Career Education: A Model For Implementation,* **Draft April 1971.**

ACKNOWLEDGEMENTS

This curriculum guide was prepared by James H. Mortensen, Instructor in Agricultural Education, The Pennsylvania State University, with assistance from the faculty of The Pennsylvania State University's Department of Agricultural Education. The Project Advisory Committee is extended the sincere appreciation of the authors. Appreciation is also extended to William Berndt, Project Officer, and H. Neville Hunsicker, Education Program Specialist, Agribusiness and Natural Resources Occupations, U.S. Office of Education, Bureau of Adult, Vocational and Technical Education, for their direction during the preparation of this guide.

Project Advisory Committee

Mrs. Eleanor Bennett, Conservation Education Advisor, Bureau of General and Academic Education, Harrisburg, PA 17126

Mr. F. Raymond Brush, Administrator, American Association of Nurserymen, Inc., 230 Southern Building, 15th and H Streets, N.W., Washington, DC 20005

Dr. Robert D. Herr, Chairman, Agriculture Department, Eastern Lancaster County School District, Route 23 and Tower Road, New Holland, PA 17557

Dr. Clyde W. Hibbs, Director, Natural Resources Institute, Ball State University, Muncie, IN 47306

Mr. Walter E. Jeske, Chief, Education and Publications Branch, Soil Conservation Service, U.S. Department of Agriculture, Washington, DC 20250

Mrs. Barbara Provost, Assistant Superintendent, Educational Services, Office of Riverside County Superintendent of Schools, Box 969, Riverside, CA 92502

Professor Howard Sidney, Chairman, Division of Agriculture and Natural Resources, State University of New York, Agricultural and Technical College, Cobleskill, NY 12043

Project Staff

Faculty and staff of the Department of Agricultural Education, The Pennsylvania State University, contributing to this project were: David R. McClay, department head; Richard F. Stinson, project director; James H. Mortensen, assistant project director; Robert L. Soles and George C. Ward, instructors; and A. Ronald Attarian and James C. Nichol, graduate assistants.

TABLE OF CONTENTS

Chapter		Page
	FOREWORD	iii
	ACKNOWLEDGMENTS	v
	USE OF THIS CURRICULUM GUIDE	ix
I.	CAREER EDUCATION IN NATURAL RESOURCES	1
	The Career Development Concept	1
	Occupation in Natural Resources	2
	Typical Activities Performed by Natural Resources Workers and Technicians	4
II	BUILDING A COMPREHENSIVE PROGRAM IN NATURAL RESOURCES	7
	General Program Considerations	7
	Faculty	7
	Student Recruitment	8
	Textbooks, References, and Other Instructional Media	8
	Library	8
	Advisory Committees	8
	Scientific and Technical Societies and Trade Associations	9
III.	THE CURRICULUM	11
	Curriculum Content and Relationships	11
	Natural Resources Mechanics	11
	Supervised Occupational Work Experience	11
	Youth Groups	12
	Suggested Continuing Study	12
IV.	OUTLINES OF UNITS	13
	Air	13
	Air Quality Control	14
	Air Pollution Sampling and Monitoring	15
	Air Pollution Analysis	15
	Fish	17
	Fish Management	17
	Fish Hatchery Techniques	18
	Forestry	20
	Management of Forest Resources	20
	Forest Disease and Pest Control	22
	Fire Prevention and Control	23
	Land Use Planning	25
	Planning and Zoning	25
	Land Measurement	26
	Surveying	27
	Minerals and Mineral Fuels	29
	Mineral and Mineral Fuel Resources	29
	Introductory Mining	30
	Mining Area Restoration	31
	Range	33
	Range Science	33
	Range Management	34
	Recreation	35
	Recreational Use of Natural Resources	35
	Natural Resource Recreational Business Aspects	36
	Development of Summer Recreation Areas	37
	Development of Winter Recreation Areas	39
	Soil	40
	Soil Morphology, Formation, and Classification	40
	Soil Conservation	41
	Management of Soil Fertility	43
	Water	45
	Water Supply	45
	Wastewater	46
	Irrigation Water Management	47
	Wildlife	50
	Wildlife Management	50
	Game Bird Propagation	51
	Surveying Wildlife and Wildlife Cover	52

TABLE OF CONTENTS (Continued)

Chapter		Page
	Auxiliary and Supporting Units	54
	Employability Skills	54
	Supervised Occupational Work Experience Programs	55
	Developing Leadership Through Youth Organizations	56
V.	FACILITIES AND EQUIPMENT	59
	General Planning Considerations	59
	Suggested Audiovisual Equipment	60
	Suggested Laboratory Equipment	60
Appendices		
A	SELECTED LIST OF TEXT AND REFERENCE BOOKS	63
B	SELECTED LIST OF AUDIOVISUAL AIDS	65
C	SELECTED LIST OF PROFESSIONAL AND TECHNICAL SOCIETIES AND ORGANIZATIONS CONCERNED WITH NATURAL RESOURCES	69

USE OF THIS CURRICULUM GUIDE

The purpose of this curriculum guide is to provide a model plan to help public high schools and area vocational-technical schools to initiate, or evaluate and improve, natural resource occupational preparation programs. It is directed toward and intended to be used by school administrators, curriculum planners, vocational instructors, counselors, and advisory committee members.

The guide provides unit outlines with suggested behavioral objectives, learning activities, and references; a sequence of career education efforts; discussion of occupational opportunities, faculty, student services, the library and its use; and a selected list of scientific, trade, and technical societies.

The guide provides a starting point for school administrators and teachers. It offers a curriculum plan which, with the aid of an advisory committee, can be modified to meet particular needs and objectives, permitting administrators and teachers to initiate a curriculum with minimum uncertainty about their program meeting its objectives. This guide can be used for preparatory occupational programs, occupational work experience programs, and for upgrading personnel. Although the indicated level of instruction is high school, the outlined units can be used at any grade level where students can benefit from them. Some units may be adapted for use in training employed adults.

The guide serves a second purpose. It educates teachers because it has a coherent and authoritative source of information which instructors of natural resource programs and department heads often need.

Chapter I.

CAREER EDUCATION IN NATURAL RESOURCES

THE CAREER DEVELOPMENT CONCEPT

The central purposes of education are to prepare the young to accept the reality of constructive pathways to adulthood, to help them enter these pathways successfully, and to assist them in finding personal relevance in the life options available to them.

One of the goals toward which the educational system must direct itself is to provide for every student the opportunity to acquire the skills which will allow him to make a livelihood for himself and for his future family, regardless of the level at which he leaves the educational system. Such skills are not confined to the manipulative skills; they are all those by which one can use his capabilities in activities which contribute both to individual fulfillment and to society's maintenance and progress.

To make public education relevant to today's needs and the needs of the future, the school program should be reviewed. It is becoming increasingly evident that public education must be focused around the theme of career development. Only through gainful employment can our citizens acquire the self-fulfillment and financial independence that are essential in a sound democratic society.

Career education is a comprehensive, systematic, and cohesive plan of instruction that will provide each student the opportunity to plan and prepare for a meaningful and satisfying role as a working member of society. A total career education effort provides instruction for individuals at each stage in the lifelong process of career development. For elementary and secondary education, grades kindergarten through 12, the effort must include a structuring of basic subjects around the theme of career opportunities, requirements, and rewards in the world of work. In elementary school, students are informed about why people work, the wide range of jobs in our society, and the roles and requirements involved. In the middle school, students explore several specific clusters of occupations through hands-on experience and field observation, as well as classroom instruction. They are assisted in selecting an occupational area for further specialization at the secondary school level. In high school, each student should be permitted to pursue his selected occupational area, with any or all of three progressively oriented objectives – intensive job preparation for entry into the world of work immediately upon leaving high school, preparation for technical positions through postsecondary occupational education, or preparation for professional careers through college education.

Those students preparing for postsecondary occupational education or four-year college entry must be provided with clusters of occupational experiences, including work experience where possible, with the academic subject areas being related to the professional area for which they are preparing. Students engaging in specialized job preparation must be provided with basic academic skills essential for further education. Consequently, every student will leave the system with at least entry-level job skills and with facility in basic academic subjects sufficient to enable entry into further education.

Sound career education not only provides job information and skill development but also helps students to develop sound work attitudes which involve the personal, psychological, social, and economic significance of work. Extensive guidance and counseling activities must be provided to assist the student in developing self-awareness and in matching his interests and abilities to potential careers.

The opportunity for placement in an entry-level job or further education is provided for every student. Thus, comprehensive career education includes a sequentially developed education program offering career orientation, career exploration, and job preparation for all students. A major benefit is that students' performance in basic subjects will probably improve as the entire curriculum is made relevant and more meaningful by being focused and unified around career education. Intensive guidance and counseling assists students in development of self confidence and mature personal attitudes. Guaranteed opportunity for placement assures that the educational system will assume responsibility for the development of every student. It also provides visible evidence for accountability in the program.

In summary, career education is designed to give every youngster a genuine career choice and the knowledge and occupational skills necessary to support it. Career education is not merely a substitute for "vocational education" or "general education" or "college preparatory education". Rather, it is a blending of all three into an entirely new curriculum. The fundamental concept of career education is that all educational experiences – curriculum, instruction, and counseling – should be geared to preparation for economic independence, personal fulfillment, and an appreciation of the dignity of work.

CAREER EDUCATION IN THE SECONDARY SCHOOL

The career development program at the secondary school level is exploratory and preparatory in nature. The program assists students in converting their vocational preference into reality. Specific objectives are:

1. To explore in depth and train in a selected occupational cluster leading to entry-level skill in one occupational area and providing a foundation for further progress, leaving open the option to move between clusters if desired.
2. To improve performance in basic subject areas by making the subject matter meaningful and relevant through unifying and focusing it around a career development theme.
3. To provide guidance and counseling.
   a. To assist students in selecting an occupational specialty with the following options: intensive job preparation, preparation for postsecondary technical programs, or preparation for a four-year college.
   b. To prepare for employment and/or further education.
   c. To insure placement of all students, upon leaving school, in:
      (1) a job
      (2) a postsecondary occupational education program
      (3) a four-year college program
4. To maintain annually revised records of all terminates and graduates in order to use the resulting information for program revision and improvement.

The purpose of this curriculum guide is to suggest a model plan for secondary schools and area vocational-technical schools to start, or evaluate and improve, career education in the natural resources.

OCCUPATIONS IN NATURAL RESOURCES

Natural resources are all of those naturally occurring materials of nature having human utility or value. The term natural resources includes, in all their forms, soil, water, air, plant life, non-human animal life, sunlight, minerals, and mineral fuels, and space on land and ocean surfaces.

The Panel on Natural Resources Science of the National Research Council defines renewable natural resources as those parts of man's environment that are useful to him and that, though used, have the potential of being maintained or improved in quantity or quality or both.

Some natural resources are non-renewable. The mineral materials which make up portions of the earth's crust, when mined, cannot be replaced or accumulated again at any foreseeable time in the future. Space on land is another non-renewable resource.

Demands upon natural resources are growing at a tremendous rate. By the year 2000, timber needs are expected to double and the demand for water will triple. Water conservation and management will become more important and more people will have to help with the task of prudently managing the water. Demand for outdoor recreation may increase as much as eight-fold by the year 2000. These trends all mean increased career opportunities for prepared individuals. With the present commitment to environmental improvement, there is likely to be a rapid change in previous employment trends in natural resources occupations. The effective demand for skilled workers and technicians to assist the professional worker can be expected to rise particularly rapidly.

Among the signals of trends in employement in natural resources occupations is the federal budget for fiscal year 1972. It includes federal expenditures in the natural resources category of 4.24 billion dollars as compared to fiscal year 1970 actual outlay of 2.40 billion dollars and fiscal year 1968 outlay of 1.65 billion dollars[1]. These figures do not include expenditures of 334 million dollars under the category of agriculture and rural development for agricultural land and water resource programs. The federal government's stated commitment to environmental improvement leads to the expectation of a continued upward trend in expenditures for natural resources. Included in the projected federal outlays are funds for grants for waste treatment facilities. Trained workers and technicians will be needed to operate these plants.

State and local government expenditures for natural resources programs have been rising and this trend is expected to continue. The 1971 *Manpower Report of the President*[2] indicates that between 1957 and 1969 there was a 30 percent increase in the number of people employed by the federal government in natural resources occupations. In that same 12-year period, there was a 52 percent increase in employment in natural resources occupations by state governments and a 65 percent increase in such employment by local governments.

Business and industry also are reacting to the public's demand for environmental improvement, and will likely increase employment in natural resources occupations. For example, there is increasing pressure for rehabilitation of strip-mined land, and this generates a demand for technicians. Enactment of sediment control ordinances by the states will mean that developers and builders will need to employ people trained in certain aspects of natural resources management.

---

[1]Executive Office of the President, Office of Management and Budget. *The U.S. Budget in Brief, Fiscal Year 1972*, January 1971, U.S. Government Printing Office, Washington, DC, pp. 36-39.

[2]United States Department of Labor, *Manpower Report of the President*, April 1971, U.S. Government Printing Office Washington, DC, pp. 166-170.

Detailed descriptions of selected jobs within each of the natural resources occupational areas are presented in the publication, *Exploring Occupations in the Natural Resources*, A Student Resource Guide for the Middle School. It was not feasible to include descriptions of the job titles in this publication. Rather, an attempt has been made to list job titles for each level of employment within each natural resource occupational area. The list that follows has been checked by educators and by employers. The titles differ in some geographic areas, and may be subject to change as work changes and new positions are created.

AIR

Entry Level
- Air Pollution Control Worker

Skilled and Technical Level
- Air Monitoring Technician
- Smoke Tester
- Compliance Section Technician
- Engineering Section Technician

Professional Level
- Air Pollution Control Supervisor
- Air Pollution Control Meteorologist
- Air Pollution Control Chemist
- Air Pollution Control Engineer

FISH

Entry Level
- Fish Hatchery Worker

Skilled and Technical Level
- Fish Farmer
- Frog Farmer
- Alligator Farmer
- Crab Farmer
- Conservation Patrolman

Professional Level
- Fish Culturist
- Fish Hatchery Superintendent
- Fisheries Scientist

FORESTRY

Entry Level
- Tree Planter
- Tree Pruner
- Tree Sprayer
- Tree Surgeon's Helper

Skilled and Technical Level
- Forestry Aide
- Forest Technician
- Woods Supervisor
- Forest Nursery Technician
- Forest Cruiser
- Logging Operations Inspector
- Forest Warden
- Smoke Jumper
- Jumpmaster
- Suppression Crew Leader
- Fire Lookout
- Fire Warden
- Fire Patrolman
- Forest Fire Fighter

Professional Level
- Forester
- Forest Entomologist
- Consulting Forester
- Forest Examiner
- Forest Supervisor
- Research Forester
- Forest Engineer
- Forest Ecologist

Forest Ranger
Silviculturalist

LAND USE PLANNING

Entry Level
- Surveyor's Assistant – Rodman
- Surveyor's Assistant – Chainman

Skilled and Technical Level
- City Planning Aide
- Urban Planning Technician
- Zoning Inspector
- Zoning Technician

Professional Level
- Chief Planner
- City Planning Engineer
- Urban Planner
- Regional Planner
- Land Use Planner
- Architectural Engineer

MINERALS AND MINERAL FUELS

Entry Level
- Mining Area Restoration Worker

Skilled and Technical Level
- Open Pit Mine Conservation Inspector
- Mining Area Restoration Technician
- Scout

Professional Level
- Petroleum Geologist
- Mineralogist
- Geologist

RANGE

Entry Level
- Pest Control Worker
- Sprayer

Skilled and Technical Level
- Range Aide
- Range Allotment Official
- Range Technician

Professional Level
- Range Manager
- Range Conservationist
- Range Scientist

RECREATION

Entry Level
- Grounds Keeper
- Park Caretaker
- Park Worker

Skilled and Technical Level
- Recreation Farm Manager
- Dude Ranch Manager
- Hunting and Fishing Guide
- Recreational Development Technician
- Fish and Game Club Manager
- Winter Sports Manager
- Ski Patrolman
- Waterways Patrolman

Professional Level
- Park Foreman
- Park Naturalist
- Park Superintendent

SOIL

Entry Level
- Surveyor's Assistant – Rodman
- Surveyor's Assistant – Chainman

Skilled and Technical Level
- Soil Conservation Aide
- Soil Conservation Technician
- Engineering Technician (Soil Conservation)

Professional Level
- Soil Scientist
- Agrogeologist (soil mapper; soil surveyor)
- Soil Fertility Expert
- Soil Bacteriologist
- Soil Conservationist
- Drainage Design Coordinator

WATER

Entry Level
- Water Filter Cleaner
- Wastewater Disposal Worker

Skilled and Technical Level
- Basin Operator
- Irrigator
- Irrigation Technician
- Watershed Tender
- Public Health Engineering Aide
- Sanitarian Aide
- Water and Waste Treatment Plant Operator
- Stream Sanitation Technician
- Oceanographic Technician
- Ocean Water Pollution Technician
- Oceanographic Laboratory Technician

Professional Level
- Drainage Design Coordinator
- Irrigation Engineer
- Limnologist
- Water Quality Chemist
- Geological Oceanographer
- Public Health Bacteriologist

WILDLIFE

Entry Level
- Game Farm Worker

Skilled and Technical Level
- Gamekeeper
- Wildlife Conservation Officer
- Animal Shelter Keeper
- Wildlife Technician
- Game Warden
- Game Propagator

Professional Level
- Wildlife Biologist

Graduates of this occupational preparation program may be expected to accept skilled worker positions. Some people with experience may enter the technical positions. It is assumed skilled employees will advance on the job to higher positions as a result of experience and further study.

After a natural resources program has been established, it is recommended that additional in-service education courses be established for the graduates and other interested adults in the evening or at times when they can take them without interfering with their work.

This program is intended to provide the education of skilled personnel who are capable of performing many tasks requiring special skills, and who are confident in their abilities, education, competence, and judgment.

Administrators, teachers, and guidance counselors planning to initiate a natural resources exploratory and preparational program should be aware of the special abilities required of skilled workers and technicians and the nature of the tasks they may be called upon to perform.

TYPICAL ACTIVITIES PERFORMED BY NATURAL RESOURCES WORKERS AND TECHNICIANS

AIR

1. Inspect industrial sites, enforce laws concerning air pollution abatement, investigate complaints.
2. Assist engineers with preparing plans, testing equipment, and selecting monitoring locations. Conduct air quality tests in a laboratory.
3. Maintain daily records on results of air quality tests. Assist with the operation of air quality monitoring systems statewide or locally.
4. Conduct demonstrations of air monitoring equipment; work with the general public.
5. Maintain a library of technical literature and provide meteorological advice and operate a program for the prevention of air pollution emergencies.
6. Work with industry and municipalities to abate air pollution. Measure pollutants in smokestacks. Testify in court on legal disputes.

FISH

1. Care for and feed fish at a fish hatchery; prepare tanks for spawning and clean tanks; oversee the fish spawning activities; regulate tank environment and sort fish according to size, color and species.
2. Operate hatchery equipment and facilities such as pumps, sieves, aerators, mowers, trucks, ponds, tanks, dams, and raceways.
3. Count fish, take fish orders, load fish for transport, and deliver them.
4. Schedule truck shipments.
5. Watch for disease symptoms; carry out prescribed treatments.
6. Maintain propagation records.
7. Use scientific techniques to study the life cycles of fish.
8. Study the natural habitat of fish, including natural food supplies, shelters, and natural enemies.

FORESTRY

1. Mark, cruise, thin, and prune trees.
2. Plant tree seedlings.
3. Patrol for fires and fight fires.
4. Observe, measure, and write down information, such as the kinds of trees, how much lumber certain groups of trees will produce, death rate of seedling trees, etc.
5. Use staff compass and chain for measuring and mapping areas.
6. Enforce rules and regulations of recreation areas and answer questions about the forest and its wildlife.
7. Collect and report on the readings of instruments, such as the rain gauge, thermometer, stream flow recorder, and soil moisture gauge.

LAND USE PLANNING

1. Review applications for building and use permits for conformity to regulations. Investigate land and building uses for safety and compliance with existing laws.
2. Assist in the collection, organization, and analysis of data required in the development of new plans and zoning regulations.
3. Work with builders and other land developers to utilize results of research projects.

MINERALS AND MINERAL FUELS

1. Enforce open pit mining laws. Fill in and close old mines.
2. Help miners stop pollution. Work to stop mine fires. Make stream surveys to see that mine drainage waters are not polluted.
3. Assist geologists in determining areas having potential sources of minerals or mineral fuels and in estimating quality and quantity of deposits found.
4. Check facilities in gas and oil fields to see that they comply with regulations. Check to determine that gas and oil by-products are not polluting land or water. Check for fire hazards.

RANGE

1. Determine the number and appropriate type of livestock to be grazed and the best season for grazing.
2. Restore deteriorated rangeland. Maintain soil and water conservation practices. Plant grasses and trees. Control brush and predatory animals.
3. Operate farm machinery, check fences, fight fires, and work on fire prevention programs.
4. Monitor brush control and brush removal programs.
5. Assist the range manager to establish grazing plans.

RECREATION

1. Supervise the operation, maintenance, and appearance of public areas.
2. Carry on daily maintenance tasks (landscaping and other cultural practices).
3. Assist in building roads, campsites, trails, and other park facilities.
4. Enforce safety regulations for public well-being.
5. Act as a guide and/or patrol man.
6. Supervise the operation of a campground.
7. Offer assistance in sport hunting and fishing; advise the hunter in his selection of equipment.
8. Enforce swimming, fishing, and boating safety laws; investigate water-related accidents.

SOIL

1. Assist in the application of soil conservation practices.
2. Conduct demonstrations and tours on soil and water conservation.
3. Advise and assist land owners and managers in carrying out soil and water conservation plans.
4. Gather and assemble information from farms, ranches, municipal watersheds, construction sites and other locations on past and present land use, apparent water management problems, and severity of erosion.
5. Help develop inventories and evaluations of natural resource data.
6. Assist the Soil Conservationist in preparing conservation plans.

WATER

1. Investigate sources of water pollution in watershed areas. Operate equipment to determine pollution levels. Advise on corrective measures. Submit reports as official records.
2. Conduct technical surveys and field investigations on water supplies for use in connection with current and future needs.
3. Make safety inspection of reservoirs, check water flow into and out of a reservoir. Issue water use permits and licenses.
4. Check wells for quality and safety; issue permits for use of water. Advise on how to prevent and/or remove pollutants.
5. Maintain and repair water treatment equipment; read meters and gauges and record data.
6. Assist in the study of the ocean contents, movements, shorelines, and marine life.
7. Control gates and gate and needle valves in aqueduct and dam to regulate flow of water to maintain reservoir elevation, irrigate fields, supply water power to operate turbines in hydroelectric plants, and for flood control.

WILDLIFE

1. Raise game birds and other wildlife.
2. Gather eggs for artificial incubation, and transfer young to rearing pens.
3. Release animals and birds in designated areas.
4. Take game counts; determine game best suited for an area.
5. Trap game in overstocked areas.
6. Use equipment to plant, fertilize, and cultivate cover and field crops. Prune trees and shrubbery in game cover areas.
7. Maintain farm machinery, buildings, and facilities.
8. Patrol assigned areas to prevent game law violations.
9. Investigate reports of fish and game law violations and issue warnings and citations.
10. Work with the public to explain fish and game laws.
11. Assist in the collection, organization, and analysis of data required for wildlife research.
12. Check hunters in the field and operate game checking stations along highways.
13. Give conservation lectures to camps and schools; give training sessions to sportsmen.

Chapter II.

BUILDING A COMPREHENSIVE PROGRAM IN NATURAL RESOURCES

GENERAL PROGRAM CONSIDERATIONS

A major component of career education is vocational skill training that provides students with specific competencies required for successful entry or reentry into the occupational world. The goal of this component is to maximize the quality, appropriateness, variety, and levels of vocational skill training from which the individual can choose. Such training must be demonstrably related to existing and anticipated occupational openings and organized in ways that will allow training opportunities to change with the needs of society.

JOB OPPORTUNITIES

Many state education departments assemble labor market information which is valuable to local school districts and other occupational training agencies that can be used to improve decisions regarding long range planning of occupational preparation programs. Write to the State Director of Vocational Education in your state for this information.

It must be emphasized that state labor market information does not replace judgment on the part of local program planners. They will need to bias state manpower information with locally developed or known data. Both sources of information should form the basis for evaluating the direction of existing and planned programs.

The following steps may be employed to survey local job opportunities in selected natural resources occupational areas. Since fifty miles is considered the maximum commuting distance for an entry level job, the survey considers supply and demand data within a 50-mile radius of the school.

1. Using a map of your state, draw a circle having a 50-mile radius with the center at the proposed school site.
2. Using industrial directories, trade directories, state and federal directories, town directories, telephone directories, and personal directories, make a list or card file of major state, federal, and private employers of workers in the identified natural resources area(s).
3. Interview the potential employers of natural resources workers.
4. Prepare a table listing the number of full time and seasonal employees by worker or sub-managerial level position, and job classification.
5. Prepare a table listing the number of full time and seasonal job openings by job classification in the survey area for each year, for the next five years. Note that population increases by about 2% annually and employee turnover is about 10% annually.
6. Prepare a table indicating the enrollment the class in the identified natural resources occupational area should have each year for the next five years. Double the employment opportunity figure found in number five (5), because 50% of the students taking an occupational preparation program are not employed in the occupational area immediately after graduation. Deduct an appropriate percentage for that portion of the survey area (50-mile radius) that is overlapped by a similar natural resources program in another school.
7. Would enrollment potential, based on job opportunities, justify a course in the selected natural resources area at the proposed school site? An enrollment of twenty students is considered to be the minimum number for an occupational preparation program.

FACULTY

The effectiveness of a natural resources occupational preparation program depends largely upon the experience, educational background, and personal qualities of the faculty. Instructors in natural resources require advanced professional preparation in the areas they are to teach. With few exceptions, they should hold at least a bachelor's degree with major emphasis in agriculture and/or natural resources and vocational education. They should have had experience in a government agency or other organization directly related to the natural resources. This background contributes to their understanding of vocational objectives and instructional requirements. Faculty members with both a theoretical and practical background can bring to the program the enthusiasm and appreciation for natural resources that are essential to the program's success.

In an occupational preparation program, there should be a team approach to teaching, with close liaison maintained between the various staff members. Coordination of classes should be discussed at staff meetings. Every classroom teacher in every course should emphasize, where appropriate, the career implications of the substantive content they teach. Such an approach can give meaning and relevance to otherwise abstract academic subject matter.

Another member of the team should be the librarian. The librarian should be included in staff meetings and curriculum discussions whenever possible. This important two-way communication will inform the librarian and the teachers of new materials which are available.

The philosophy of the team approach is to emphasize the integrity of the program. The aims and objectives are to give every student a genuine career choice, as well as the intellectual and occupational skills necessary to back it up. This can be accomplished best when all educational experiences – curriculum, instruction, and counseling – are geared to preparation for economic independence, personal fulfillment, and an appreciation for the dignity of work.

The institution must insure that its faculty workload permits time for individual and departmental activities as well as the supervision of students on the job. Faculty members should have appropriate training aids and supplemental material for their respective courses and a working knowledge of what others are teaching in natural resources, agriculture, and related course content.

Not all of the units recommended in the program of study for a natural resources occupation curriculum necessarily require that staff trained in natural resources teach them. Often faculty from other departments might be better able to teach a particular class; units dealing with soil might be taught by the teacher of agriculture or earth science. Units in plant and animal science (forestry, game propagation, etc.) could be taught by the biology instructor.

Other potential sources of instructional assistance might

include practical demonstrations by resource persons from local natural resources agencies and related practitioners.

Faculty members should be encouraged to participate in activities and organizations which lead to personal professional development, through offering released time and financial assistance for in-service training. The in-service training program should be developed to strengthen individual weaknesses. One teacher may profit more from summer employment in industry, while another should attend formal classes. Maintaining close contact with practitioners and current literature in the field through special institutes and conferences should provide a basis for constant updating of material for their courses.

STUDENT RECRUITMENT

While the effectiveness of an occupational preparation program depends greatly upon the quality of the faculty, the program's ultimate objective is to produce high quality graduates. It is essential, therefore, that the students entering the program have certain interests and capabilities and that they exhibit evidence of maturity and seriousness of purpose. To permit students to enter an occupational program without certain interests and capabilities invites failure of the student or of the program or both, causes disillusionment of students and their families, and is a disappointment to the school. All students and faculty should be informed about the program and the opportunity it provides to prepare students for natural resource occupations. Active recruitment will encourage students to apply for admission to the program.

The decision to enter the program must reflect the student's desire to undertake it with a knowledge of its nature and its potential contributions to the student's occupational aspirations. It is important that students:

1. Want to enter the program.
2. Accept the fact that it provides an opportunity to prepare them for the occupation of their choice.
3. Realize that supervised occupational work experience is a necessary and important part of the program.
4. Are willing to devote the time and energy required to undertake the program including the supervised occupational work experience.
5. Reasonably expect to secure employment successfully upon graduation, or to undertake a technical or professional natural resources curriculum.

A personal interview with all applicants to the program is recommended. Evidence of interest in a natural resources occupation may best be determined in an interview.

Counseling students for natural resources career education must be based on the evaluation of all the pertinent information available and the judgment of the guidance personnel of the school. The interest and aptitude for the natural resources occupation each student is aspiring to enter should be carefully evaluated.

TEXTBOOKS, REFERENCES, AND OTHER INSTRUCTIONAL MEDIA

Textbooks, references, visual aids, and other instructional resources are important tools of the teaching profession. They must be reviewed, supplemented, and revised constantly to reflect new developments and trends - particularly those being adopted by industry and public agencies. Teachers should be aware that there is often a time-lag of several years between research findings and their application and adoption in practical settings.

The suggested texts and references listed for each unit have been carefully selected for appropriateness. It should be noted that any list quickly becomes outdated and a teacher must evaluate new material regularly.

Before undertaking a program in natural resources or any unit contained in this guide, it is urged that the instructor become familiar with the texts and references listed here and any new ones available. The instructor should also study non-text material such as publications from experiment stations. The instructor will then be in a position to select text materials which serve his particular needs best.

Departures from teaching the traditional courses are creating a need for new and different books and references. In many cases, it will be necessary for the teacher to develop his own teaching materials. It also may be necessary for students to read from many different sources rather than to have one assigned text.

Students should be encouraged to use the library to look up materials and to become acquainted with sources of information. In a changing technology, knowing how to find information is as important as knowing facts. Some class assignments in the library are necessary to familiarize the student with its use. The success of the graduates of this program will depend in large measure on their ability to keep abreast of changes in the field.

Visual aids are of major importance in many teaching situations if they are effectively used to complement and supplement classroom and laboratory experiences. An instructor should select those visual aids which meet his teaching objectives. All visual aids should always be previewed and should be integrated with course material.

Innovative instructional techniques should be thoroughly studied and perhaps tested before being used. A flexible program of considered experimentation will often add new dimensions to old courses and develop improved teaching methods. By experimenting on a limited basis before full implementation, the natural resources curriculum will not be seriously imperiled by innovations that are good in theory but poor in practice.

LIBRARY

The rapidly evolving trends and developments in career education for natural resources make the library a mandatory tool for the program's students. Classroom work should rely on library-oriented study so that the students become intimately acquainted with information resources and their use. This experience helps the student develop a professional attitude and will serve the individual in good stead later as a practitioner.

Most instructors have office libraries from which they may select materials for student conferences or for personal loan. However, a central library with accessible catalogued reference materials is essential for controlled and orderly student use. In addition to reference books on all important aspects of the development, maintenance, protection, and recreational utilization of natural resources, the library should contain current magazines pertaining to natural resources, bulletins and information from the local extension service and other governmental agencies, and a wealth of trade and commercial literature. The library should have encyclopedias available for quick reference and should maintain index material such as educational indices to aid staff and students in locating recent material on specific subjects. Appendices A and B provide lists of suggested materials.

To insure that the central library maintains the most up-to-date materials, the faculty should keep the head librarian informed of new books, periodicals, pamphlets, and other information resources for possible acquisition.

Similarly, the library staff should supply the faculty with a periodic list of recent acquisitions, complete with call numbers. Technical and trade journals should be circulated to the teaching staff or placed in a reserve area before they are made available for general library use.

An instructional media center should also be a library resource. Both library and staff representatives should review and evaluate visual aids as they become available to insure timely and pertinent use in classroom situations. References which appear after each unit in this guide should all be included in the library.

ADVISORY COMMITTEES

Advisory committees can assist the secondary institution administration in planning and implementing natural resources programs to meet the objectives of the institution, the student, and the community.

The special advisory committee for the natural resources occupational programs should include representatives of employers

and public employment services, scientific or technical societies and associations in the field, and knowledgeable civic leaders who meet with and advise the specialists on the school staff. The committee normally consists of about nine to twelve members who generally serve for a one to three year period. The head of the institution or the department head is ordinarily chairman. Members are appointed for regular terms, subject to reappointment, and membership should rotate so some experienced advisors are present with some new ones each term. It should be remembered that advisory committee people are busy; therefore, meetings should be called only when committee action can best handle a specific task or problem.

Letters of appointment should come from the chief school administrator. While the committee functions without legal status or powers, it can provide invaluable assistance to the institution by assisting in a feasibility study of proposed new educational programs, by providing support to school administrators in obtaining appropriations and state and federal support to finance the programs, by assisting in the location of work experience stations, by surveying and defining the knowledge and skills needed by natural resource workers, and by assisting in the placement of graduates (in jobs).

This guide, designed primarily for planning and development of programs in high schools, can be used by the advisory committee as a starting point, modifying it to meet local needs. The units suggested in this guide can also form the basis for courses to meet the requirements of employed adults who wish to upgrade or update their skills and technical capabilities. In this way the school administration, with the help of the committee and special consultants, can effectively initiate the needed program, quickly develop it to a high level of excellence, and maintain its timeliness.

SCIENTIFIC AND TECHNICAL SOCIETIES AND TRADE ASSOCIATIONS

Scientific and technical societies and trade associations are an important source of instructional materials and other benefits for faculty members and students. These societies, in their publications and at meetings, provide continual exposure to the most recent developments in the science and related technologies, and probably serve as the best means for helping persons keep up-to-date in a particular phase of science.

Less conspicuous, but extremely important, is the support which societies may give (1) in helping to develop evidence of the need for a training program; (2) in helping to promote the program; (3) in enlisting members' support for the program; (4) in helping to provide work experience for students; and (5) in helping with the placement of graduates.

Associations and societies may supply resource people to speak to classes. They also may serve as hosts to student groups on field trips to study specific phases of the industry.

Teachers in technical programs should be encouraged to become active members of scientific and technical societies in order to keep abreast of new developments in the technology and to become acquainted with the people in the community who are most actively interested in the field.

Early in their studies students should be required to become acquainted with the literature and services of scientific and technical societies. They also should be encouraged to join those which offer student affiliate memberships.

The following is a selected listing of some of the organizations and associations which are pertinent to natural resources. Complete addresses are listed in Appendix C.

Air Pollution Control Association
American Congress on Surveying and Mapping
American Fisheries Society
American Forest Institute
American Forest Products Industries
American Forestry Association
American Geological Institute
American Geophysical Union
American Institute of Planners
American Meteorological Society
American Petroleum Institute
American Pulpwood Association
American Society of Photogrammetry
American Water Resources Association
American Water Works Association
Association of Interpretive Naturalists
Conservation Education Association
Ecological Society of America
Entomological Society of America
Incinerator Institute of America
Institute of Environmental Sciences
National Association of Sanitarians
National Coal Association
National Parks and Conservation Association
National Recreation and Park Association
National Wildlife Federation
The Society of American Foresters
Society for Range Management
Soil Conservation Society of America
Soil Science Society of America
Water Pollution Control Federation
Wildlife Management Institute
The Wildlife Society

Chapter III.

THE CURRICULUM

CURRICULUM CONTENT AND RELATIONSHIPS

This curriculum guide outlines units of instruction basic to the preparation of individuals for employment in natural resources occupations. The units of instruction outlined in Chapter IV are organized around the natural resources occupational areas of air, fish, forestry, land use planning, minerals and mineral fuels, range, recreation, soil, water, and wildlife.

Each unit may be interchanged, added to, or deleted. Units such as "Soil Conservation," "Irrigation Water Management," and "Planning and Zoning," may have implications for more than one of the ten natural resources occupational areas.

If students are to have access to career education that is purposeful, continuing, individualized, practical and attainable, then the school must teach courses that can be used to best meet specific student needs and aspirations, community development, and labor market needs. The agribusiness and natural resources faculty assisted by the advisory committee members must select appropriate instructional units to build a course of study which meets the occupational needs of the students and the community.

A course of study for a class that meets five times per week during a nine month school year may be organized to include from five to eight instructional units. Each unit should contribute the maximum information, yet dovetail with other units in an appropriate sequence in order to establish a well-rounded curriculum. The units also may be used in quarter or semester courses or singly as mini-courses or modules.

It is expected that these unit outlines will be modified in some measure to fill the needs as defined by local advisory committees to emphasize the important characteristics of natural resources and occupational opportunities in the region. Members of the advisory committee, especially those representing employers, can assist the faculty in counseling and guiding each student in attaining his individual goals by recommending the particular units and practical experiences required for his career development, the time to be spent on each, and the laboratory facilities, equipment, and textbooks to be used. However, the implied level, quality, and completeness of the program should not be compromised.

The varying abilities of students, the varying levels of competence required in different occupations, and the varying facilities and resources make it difficult to establish a fixed time for any unit of instruction.

NATURAL RESOURCES MECHANICS

Education basic to the preparation of individuals for entry level positions dealing with the natural resources involves applied mechanics along with knowledge and skills specific to each job. For several of the natural resources occupations some competence is necessary in assisting with and/or performing the common and important operations or processes involved in the selection, operation, maintenance, and use of power, machinery, and equipment; the construction and maintenance of buildings; the installation and maintenance of electrical systems; the performance of the mechanical activities in soil and water management; and the selection, use, and maintenance of hand and power tools.

Natural resources mechanics may be taught as a separate unit or integrated with other natural resources units such as one week out of every three or two days per week. The treatment of this instruction is up to the individual instructor. Many excellent curriculum materials in the areas of agricultural and natural resources mechanics have been prepared by commercial companies, state education departments, and agriculture teacher education departments. Write the Director of Vocational Education in your state for a list of these resource materials.

Where highly competent agricultural mechanics instructors or trade and industrial instructors are already offering courses to develop competence in these mechanical areas, it is the natural resources instructor's responsibility to guide students into the appropriate mechanics units or course offerings.

SUPERVISED OCCUPATIONAL WORK EXPERIENCE

A supervised occupational work experience program is a plan for student learning through coordinated study and employment experience, alternating periods of attendance at school with periods of employment in government, business, or industry. The employment constitutes an essential element in the educational process. The student's employment should be related as closely as possible to some phase of the field of study in which he is engaged.

When a student tests his academic theory in a work situation, study becomes more meaningful. The student learns not only the applied essentials of his knowledge and skills, but also the importance of reliability, cooperation, and judgment as an employed worker in his chosen field.

Students career choices are stimulated and shaped by their work experiences. Should they find satisfaction in their work, they return to the classroom stimulated to learn as much as possible about their future career. Should they find through their work experience that they are not fitted to a specific area of work, they may decide to change their major field of study. This decision may prevent them from wasting their time and money on misguided choices of study.

The institution should permit released time for supervised occupational work experience programs. Students are released from school early, or from study hall periods, or allowed to carry lighter class loads in order to work. Summer work experience is recommended and should be a mandatory requirement between the junior and senior year.

Specific employment is obtained, as circumstances permit, by the school with the cooperation of the student. The school regards the work experience program as an integral part of the education process. It is not to be regarded primarily as an earning opportunity, although all students while working are paid at the prevailing wage scale for the job they hold. Work is closely supervised by the school work program coordinator or teacher of natural resources.

The supervised occupational work experience program is an opportunity to gain directly related experiences which make the student more desirable as an employee. Many students, as a result of their work experience with a particular establishment, have been offered permanent positions with that organization upon completion of their schooling. Cooperating establishments agree, however, not to make offers of employment which become effective before completion of the occupational preparation program.

Supervised occupational education programs provide special opportunities for the school to maintain close contact with employers in their various programs. This contact becomes a

valuable two-way channel of communication which helps the school to keep its knowledge of specific employer needs in the field up-to-date and at the same time keep employers acquainted with and involved in the program of the school.

YOUTH GROUPS

Youth group activity should be an integral part of the learning for students preparing for natural resources occupations. Youth group activities can supplement the teaching and make the program more meaningful to the student. Learning to work within a group structure is important because these students will become members of business groups, unions, civic and social groups. The youth group activity provides the student with an opportunity for group identity.

Several national youth organizations are designed to promote youth leadership development as an integral part of vocational curricula. Their overall purpose is to guide the students development in the vocational, civic, and occupational areas. The youth organizations establish realistic vocational goals to improve communication and define the student's role in society through youth-planned and directed activities that emphasize individual growth and group participation. The Future Farmers of America (FFA) is the national organization for students in agribusiness and natural resources, therefore, it is discussed here. Vocational Industrial Clubs of America, Distributive Education Clubs of America, Future Business Leaders of America, and Future Homemakers of America are some of the other youth groups which could serve this purpose.

FFA

The Future Farmers of America (FFA), the national organization for students in agribusiness and natural resources, includes agricultural production, agricultural supplies and services, agricultural mechanics, ornamental horticulture, natural resources and environmental science, agricultural products, and forestry. Launched at Kansas City in November 1928, the organization has continued to develop rapidly. Active membership is 427,888 in 7,845 chapters.

The primary aim of the FFA organization is the development of agricultural leadership, cooperation, citizenship, and patriotism. Other purposes include: strengthening the confidence of youth in themselves and their work; more intelligent choice of agricultural occupations; improving the rural home and its surroundings; encouraging thrift; improving scholarship; providing organized recreational activities and supplementing, by means of student-initiated and student-directed activities, the systematic instruction offered to students regularly enrolled in vocational agriculture and natural resources courses. For additional information concerning the organization and administration of the FFA youth organization, contact: National Executive Secretary, Future Farmers of America, P.O. Box 15160, National FFA Center, Alexandria, Virignia 22309.

SUGGESTED CONTINUING STUDY

A secondary school natural resources program cannot make the individual proficient in all duties he may be asked to perform. Proficiency comes with experience, practice, and further study of specialized problems that may arise on the job. It is also impossible to predict changes that may arise due to our changing economy and technology. Some form of continuation of study for graduates of occupational programs is necessary.

Although the student can keep abreast of technical developments in the field by reading current literature related to natural resources, continuation of the educational process provides the most efficient and practical means for the graduate to add important related areas of knowledge and skill to his initial preparation. For the individual not continuing formal education in a post-secondary technical program or baccalaureate program at a four-year college or university, an adult education program is needed. Supplementary courses offered by the school have the advantages of systematic organization of subject matter, disciplined and competent teaching, class discussion, and scheduling on evening or Saturday hours outside of the employed graduate's working day.

Some suggested continuation or extension courses for graduates of this curriculum are:

Personnel Management
Advanced Fire Protection
Advanced Surveying
Water Quality Control
Instrumentation and Controls
Environmental Design
Soil Properties for Urban Development
Wildlife Ecology

The productive graduate worker will continue to study throughout his career in order to develop to his fullest capabilities and to avoid technological obsolescence.

Chapter IV.

OUTLINES OF UNITS

The outlines of units which follow are intended to suggest the content which might be taught in the curriculum. These units of instruction have been designed to provide the high school student with basic background information to understand the environment in which he will work, as well as provide for broad skill training and minimum experience necessary to be a productive employee in an entry level job. In addition, these units of instruction can provide the educational foundation needed to undertake further study through in-service training, post high school technical education, or enrollment in a baccalaureate degree program.

In preparing these unit outlines, several factors influenced the final content:

1. The duties and responsibilities which graduates may be expected to perform.
2. Personnel requirements imposed by employers.
3. Normal variance in the competence, interests, and background experience of instructors.
4. The wealth of knowledge that must be imparted to average students in a limited secondary curriculum.

Each proposed instructional unit suggests many student learning activities to enhance skill development. Reducing activity often lowers morale, causes student apathy, and results in program dropouts. A less stringent program may also produce a graduate who is deficient in essential skills, untrained for his occupational objective, and therefore unemployable.

When properly implemented, the following instructional units will offer the student a functionally unified educational program, exposure to both theoretical principles and practical applications and supervised occupational work experience.

AIR

The units of instruction which follow are basic to the preparation of individuals for entry level employment in air pollution control.

BEST COPY AVAILABLE

Figure 2. Air pollution control aide (left) recording data. This individual often assists air pollution control technicians (right) or air pollution control supervisors. Courtesy Pennsylvania Department of Environmental Resources.

Unit

AIR QUALITY CONTROL

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Demonstrate an understanding of the natural processes in the atmosphere by defining and describing:
   a. Air
   b. Radiation
   c. Conduction
   d. Convection
   e. Wind
   f. Inversion
2. List five sources of air pollutants and describe their effects on the environment.
3. Describe the physical, chemical, and radioactive properties of six pollutants.
4. Demonstrate the ability to express concentrations of smoke density, suspended particulates, dustfall, and radioactive material.
5. Describe the use of planned industrial site selection and zoning for maintaining the quality of air.
6. List and describe six types of air pollution control equipment.
7. Describe three natural ways to control air pollution.

Unit Outline

I. Natural Processes in the Atmosphere
   A. Anatomy of air
   B. Energy from the sun
      1. Radiation
      2. Conduction
      3. Convection
   C. Wind
   D. Air temperature
   E. Inversion

II. Pollution of the Atmosphere
   A. Source of pollutants
      1. Industries
      2. Municipalities
      3. Individuals
      4. Internal combustion engine
      5. Agriculture
   B. Physical properties
      1. Particulates
         a. Size
         b. Prevalance
         c. Properties
      2. Gases
   C. Chemical properties
      1. Sulfur
         a. Sulfur oxides
         b. Hydrogen sulfide
      2. Carbon
         a. Carbon monoxide
         b. Carbon dioxide
         c. Soot
      3. Hydrocarbons
         a. Olefins
         b. Aromatics
      4. Nitrogen
         a. Nitric oxide
         b. Nitrogen dioxide
      5. Fluorine
      6. Ozone
      7. Photochemistry
      8. Other Pollutants
         a. Lead
         b. Beryllium
         c. Arsenic
         d. Asbestos
   D. Radioactivity
      1. Nature of radioactivity
         a. Alpha rays
         b. Beta rays
         c. Gamma rays
      2. Isotopes
      3. Ionization
      4. Sources of radioactivity
      5. Effects of radioactivity

III. Expressing Concentrations of Pollutants
   A. Smoke density
   B. Particulates, suspended
   C. Dustfall
   D. Radioactive materials
   E. Gases

IV. Effects of Air Pollution
   A. Health of humans and animals
   B. Aesthetics and visibility
   C. Climate
   D. Vegetation
   E. Economic aspects
   F. Materials

V. Maintaining Quality Air
   A. Site selection and zoning
      1. Planning and land use
      2. Zoning ordinances
      3. Large air pollution zoning jurisdictions
      4. Inter-state compacts
      5. International agreements
      6. Plant location
   B. Controlling air pollution
      1. Process changes
         a. Substitution of raw materials or fuels
         b. Modification of equipment
         c. Improvement of operating procedures
      2. Application of control equipment
         a. Gravity settling chambers
         b. Inertial separators
         c. Cyclonic separators
         d. Filters
         e. Electrostatic precipitators
         f. Scrubbers
         g. Incinerators
      3. Natural control of pollution
         a. Use of tall stacks
         b. Use of optimum dispersion conditions
         c. Precipitation

Suggested Learning Activities

1. Survey local community and list possible sources of air pollution.
2. Take field trip to industry to observe pollution control devices in action.
3. Have representative of tuberculosis and respiratory association give talk on the effects of air pollution on man and animals.
4. Take a field trip to a garage and have a mechanic demonstrate the function of emission control devices on automobiles.
5. Examine typical air pollution data to become familiar with terms for expressing concentrations of pollutants.
6. Examine vegetation exhibiting the effects of high concentrations of air pollutants.

References

Air Pollution Control Association. *Air Pollution Experiments for Junior and Senior High School Science Classes.*

Barker and others. *Air Pollution.*

Corman. *Air Pollution Primer.*

Stern. *Air Pollution,* Vol. I, II, III.

Unit

AIR POLLUTION SAMPLING AND MONITORING

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. State three reasons for sampling air.
2. Demonstrate three methods of sampling particulate matter.
3. Identify and describe four types of static samplers used for testing gaseous pollutants.
4. Recognize and describe the function of:
   a. Dustfall buckets
   b. Lead dioxide candles
   c. High volume filter samplers
5. Perform the sampling of air using equipment in (4).
6. Describe the routine to follow in selecting sampling sites, including the conditions to look for and the actions to take, and then perform the procedure.

Unit Outline

I. Air Pollution Sampling
   A. Need for sampling air
      1. Meeting occupational health standards
      2. Determining ambient concentrations of pollutants
      3. Locating the origin of pollutants
      4. Determining the efficiency of control equipment
   B. Approaches to sampling
      1. Sampling emissions from fixed pollution sources
      2. Community air sampling
   C. Sampling the air
      1. Particulate matter
         a. Visual methods
            1.) Ringelmann charts
            2.) Photometric devices
            3.) Nephelometer
         b. Settling devices
            1.) Chambers
            2.) Petri dishes
            3.) Microscope slides
            4.) Fallout containers
         c. Filtration devices
            1.) Sampling trains
            2.) Membrane filters
            3.) Hi-vol samplers
            4.) Tape sampler
      2. Gaseous pollutants
         a. Static samplers
            1.) Lead dioxide candles
            2.) Sulfation plate
            3.) Deterioration of rubber
            4.) Limed filter paper
            5.) Fabric panels
         b. Sampling trains
         c. Automatic sampling devices
         d. Vegetation analyses
         e. Grab sampling

II. Monitoring the Atmosphere
   A. Preparing for air surveys
      1. Air sampling networks
      2. Meteorological observation networks
      3. Aerometric station networks
      4. Air sampling stations
         a. Type I
            1.) Dustfall buckets
            2.) Lead dioxide candles or plates
         b. Type II
            1.) Dustfall buckets
            2.) Lead dioxide candles or plates
            3.) High volume filter sampler
            4.) Wind speed indicator
         c. Type III
            1.) Dustfall buckets
            2.) Lead dioxide candles or plates
            3.) Wind speed and direction
            4.) Miscellaneous sampling equipment for sampling SO_X, NO_X, oxidants, and CO
   B. Selecting sampling sites
      1. Position of sites in relation to buildings
      2. Position of sites in relation to trees
      3. Power availability
      4. Air sampling station supports
      5. Protection from vandalism

Suggested Learning Activities

1. Construct a wind direction indicator and anemometer and determine the wind patterns in a particular geographic area and the distance particulates travel.
2. Take a field trip to an air sampling station. Observe the types of sampling devices and meteorological equipment present.
3. Examine maps of several community or regional air sampling networks. Investigate the reasoning behind the selection of the sampling sites.
4. Examine the results of air sampling surveys.
5. Sample the laboratory air using each of the following:
   1. Photometric devices
   2. Nephelometer
   3. Membrane filter
   4. High volume sampler
   5. Tape sampler
   6. Lead dioxide candles

References

Air Pollution Control Association. *Air Pollution Experiments for Junior and Senior High School Science Classes.*

Devorkin and others. *Source Testing Manual.*

Stern. *Air Pollution.* Vol. II.

Unit

AIR POLLUTION ANALYSIS

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. When given the task of analyzing ambient particulates, identify three samplers available for use in conducting air tests, and using one of the samplers, perform the sampling and analyses.
2. When given the task of analyzing gaseous pollutants, recall the names of relevant testing methods, and using these tests, describe the routine to follow and its frequency, the conditions to look for, and the actions to take.
3. Give the sampling tools in (B), actually perform the procedure.
4. Recognize and recall the definitions of:
   a. Mean
   b. Median
   c. Mode
   d. Range
   e. Variance
   f. Standard deviation
5. Demonstrate a knowledge of graphic techniques for presenting data, select an appropriate technique to present the data obtained in (1) and/or (3), and perform the procedures for graphing.

Unit Outline

I. Analyzing Ambient Particulates
   A. Dustfall containers
      1. Screening
      2. Soluble solids
      3. Insoluble solids
   B. High volume filter sampler
      1. Total weight of suspended particulates
      2. Weight of solvent soluble fractions
      3. Radioactivity
   C. Tape samplers
   D. Other

II. Analyzing Gaseous Pollutants
   A. Sulfur dioxide
      1. Colorimetric SO_2 detection
      2. Time-discoloration measurements
      3. Lead dioxide candles
      4. Sulfation plates
      5. Electro-chemical methods
   B. Hydrogen sulfide
      1. Lead acetate test paper
      2. Silver cyanide detector
      3. A.I.S.I. hydrogen sulfide sampler
      4. Cadmium hydroxide - methylene blue method
   C. Oxides of nitrogen
      1. Sampling train configuration
      2. Preparation of Saltzman reagent
      3. Preparation of potassium permanganate
      4. Spectrophotometric analysis
   D. Oxidants
      1. Neutral-buffered potassium iodide method
      2. Rubber cracking method
   E. Miscellaneous techniques
      1. Hydrocarbon analyzer
      2. Halogen detector
      3. Fabric panel
      4. Corrosion plates
      5. Silver coated plates
   F. Carbon monoxide and carbon dioxide

III. Presenting the Data
   A. Collecting data
      1. Tabular form
      2. Graphic (chart) readouts
      3. Digital readouts
   B. Reducing data
      1. Graphic techniques
         a. Frequency tables
         b. Frequency polygons
         c. Histograms
         d. Cumulative frequency distribution
      2. Particle size data
         a. Frequency distribution curves
         b. Cumulative distribution curves
      3. Analyzing data
         a. Measures of central tendency
            1.) Mean
            2.) Median
            3.) Mode
         b. Measures of variability
            1.) Range
            2.) Variance
            3.) Standard deviation

IV. Comparing Data
   A. Survey reports
      1. Local surveys
      2. Regional surveys
      3. Continuous air monitoring program
      4. National air sampling network
   B. Publications
      1. Professional journals
      2. Environmental Protection Agency publications
      3. Other

Suggested Learning Activities

1. Collect a sample of particles in the classroom air on a membrane filter. Collect a sample of particles in the outside air. Compare the samples under the microscope.
2. Place the high volume sampler and tape sampler at pre-selected sites in the community. Operate for 24 hours. Analyze the samples taken by the high volume sampler and the automatic tape sampler. Compare the results.
3. Conduct a community air pollution survey. Conduct the survey for at least 60 days.
   a. Set up sampling stations
   b. Select two or more sampling methods
   c. Place the sampling apparatus in the community sampling stations
   d. Collect the sampling apparatus after an appropriate length of time and analyze the samples
4. Assemble a sampling train for sampling by the condensation (freezeout) method.
5. Operate an automatic sampler with special tape for sampling hydrogen sulfide.
6. Set up a 24 hour sequential sampler and sample for some of the following:
   a. Oxides of nitrogen
   b. Oxidants
   c. Oxides of sulfur
   d. Organic compounds
   e. Inorganic gases
7. Using a set of data representing pollutant levels for a given hour of the day for several days, construct the following:
   a. Frequency table
   b. Frequency polygon
   c. Histogram
   d. Cumulative frequency distribution
8. Plot a frequency distribution curve and a cumulative distribution for a set of particle-size measurements. Calculate:
   a. Mean
   b. Median
   c. Range
   d. Standard deviation
9. Estimate pollution levels in the community using available data on other communities.
10. Locate one or more sources of air pollution data in the library.

References

Air Pollution Control Association. *Air Pollution Experiments for Junior and Senior High School Classes.*

Barker and others. *Air Pollution.*

Stern. *Air Pollution.* Vol II.

U.S. Department of Health, Education and Welfare, Public Health Service. *Air Pollution Measurements of the National Air Sampling Network.*

BEST COPY AVAILABLE

The units of instruction which follow are basic to the preparation of individuals for entry level employment related to fish management.

Figure 3. A fish hatchery worker feeding fish at Mescalero National Fish Hatchery, New Mexico. Courtesy Bureau of Sport Fisheries and Wildlife.

Unit

FISH MANAGEMENT

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Identify ____ game fish and non-game fish.
2. Write and map a workable plan for establishing a fish pond, considering:
   a. Soil and topography
   b. Size and construction
   c. Water system
   d. Water supply
   e. Water quality
   f. Fish species
   g. Carrying capacity
3. Check for symptoms of oxygen deficiency and prescribe a remedial program.
4. Test oxygen content of a given pond to accuracy of 2 parts per million.
5. Test pH of water in a given pond to within 1 pH level of accuracy.
6. Test water temperature of a lake or pond with accuracy within ±3°. Determine stratification and fish adaptability.
7. Develop a complete written management plan for a designated stream, lake, or pond, considering:
   a. Oxygen supply
   b. Controlling undesirable fish, snakes, frogs
   c. Controlling weeds, diseases, and parasites
   d. Fishing pressure
   e. Feasibility and timing of stocking

Unit Outline

I. Introduction
   A. Gamefish
   B. Panfish
   C. Baitfish
   D. Trashfish
II. Managing and Establishing Fish Ponds
   A. Soils and topography
   B. Number and size
   C. Construction
      1. Equipment
      2. Depth
      3. Drains
   D. Water system
   E. Water supply
      1. Well water
      2. Spring water
      3. Surface water
      4. Artesian wells
      5. Creeks and streams
   F. Water quality
      1. pH
      2. Hardness
      3. Oxygen concentration
      4. Chemicals
      5. Trashfish infestation
      6. Weeds
      7. Temperature
      8. Muddiness
      9. Depth

G. Selecting fish species
   1. Bass
   2. Trout
   3. Pike
   4. Bream
   5. Shellcracker
   6. Crappie
   7. Shiners
   8. Minnows
   9. Tropical fish
   10. Catfish
   11. Other
H. Stocking ponds
   1. Pond size
   2. Growth rate
   3. Stocking rate
I. Economics
   1. Potential income
      a. Collecting fishing fees
      b. Selling fish
   2. Preliminary expenses
      a. Size
      b. Shape
      c. Equipment
      d. Labor
   3. Maintenance
   4. Feed
   5. Taxes
   6. Labor

III. Management of Streams, Lakes and Ponds
A. Oxygen deficiencies
   1. Checking for symptoms of oxygen deficiency
      a. Morning check
      b. Feeding check
      c. Water color
      d. Oxygen test kit
   2. Remedying oxygen deficiencies
      a. Aeration pump
      b. Superphosphate
      c. Potassium permanganate
B. Availability of natural fish foods
C. Controlling undesirable fish
D. Muddy water
E. Physiological shock
F. Predaceous insects
G. Snakes
H. Frogs
I. Waterweeds
   1. Common weeds
   2. Chemicals used
   3. Biological control
J. Diseases and parasites
K. Off-flavor
   1. Seriousness
   2. Prevention
   3. Causes
      a. Algae blooms
      b. Muskgrass
      c. Overfeeding
      d. Organic matter
      e. Chemicals

Suggested Learning Activities

1. Have students collect specimens of important game and baitfish species in the area.
2. Visit existing ponds and discuss various related aspects.
3. Draw to scale blueprints of pond designs and arrangements.
4. Discuss multiple use aspects of fish ponds and, if possible, visit pond or ponds where these practices are being followed.
5. Have resource person discuss quality aspects of water for fish pond use.
6. Stock aquarium with tropical and baitfish.
7. Visit local ponds at time of stocking and observe procedure.
8. For a given pond, calculate the quantities of fish needed based on pond size and fish ratio.
9. Reduce oxygen in aquarium by various techniques (stop oxygen pump, reduce light, artificial injection of carbon dioxide) and then restore oxygen. Observe the fish.
10. Make a cost analysis of establishing a pond.
11. Practice testing pH and oxygen content of water samples.

References

U.S. Department of Agriculture. *How to Manage a Trout Farm.*
U.S. Department of the Interior. *Construction Costs, Operational Expenses, and Methods Employed in Fish Farming.*

Unit

FISH HATCHERY TECHNIQUES

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Write and map a workable plan for establishing and managing brood ponds, considering:
   a. Size of containers
   b. Water quality
   c. Stocking
   d. Handling of eggs and fry
2. Prepare a written report prescribing a feeding program for fry and growing fish considering:
   a. Analysis of feed
   b. Physical form
   c. Frequency of feeding
   d. Method
   e. Amount
   f. Winter feeding
3. Determine the stocking rate for a given pond.
4. Handle at least 100 live trout or bass with a mortality rate of less than 10 percent and place in private ponds as part of a work experience program.

Unit Outline

I. Fish Hatcheries
   A. Brood ponds
      1. Size of containers
      2. Spawning containers
      3. Draining
      4. Maintaining pH
      5. Aeration
      6. Fertilization
   B. Stocking brood fish
      1. Breeders
      2. Time of stocking
      3. Spawning
         a. Pond spawning
         b. Pen spawning
   C. Handling of eggs and fry
   D. Growing fingerlings
      1. Growth rate
      2. Stocking rate
II. Feeds and Feeding
   A. Analysis of feed

B. Forms of feed
C. Feeding fry
   1. Frequency
   2. Method
   3. Quantity
D. Feeding growing fish
   1. Based on temperatures
   2. Frequency
   3. Location
   4. Types of feeders
      a. Clock dispensers
      b. Release devices
      c. Quantity
E. Winter feeding
   1. Quantity
   2. Temperature

III. Fertilization
   A. Time and frequency of fertilization
   B. Types
   C. Quantities
   D. Placement

IV. Stocking Streams, Lakes and Ponds
   A. Size
   B. Growth rate
   C. Stocking rate
      1. Surface water
      2. Running water

Suggested Learning Activities

1. Visit a fish hatchery.
2. Check pH of aquarium water and correct if necessary.
3. Vary spawning conditions in aquarium and observe results.
4. Bring several types of feeds to class and allow students to examine and discuss reasons for differences.
5. Visit and observe feeding operations at a local pond.
6. Observe feeding habits of fish in aquarium. Compare differences in feeding habits of various species.
7. Visit a local pond at time of fertilization.
8. Fertilize an aquarium and observe results.
9. Determine the stocking rate for a given pond.

References

U.S. Department of Agriculture. *How to Manage a Trout Farm.*
U.S. Department of the Interior. *Construction Costs, Operational Expenses, and Methods Employed in Fish Farming.*

FORESTRY

The units of instruction which follow are basic to the preparation of individuals for entry level employment in forestry.

BEST COPY AVAILABLE

Figure 4. A forester aide planting seedlings on a contoured hillside. Courtesy Weyerhaeuser Company, Tacoma, Washington.

Unit

MANAGEMENT OF FOREST RESOURCES

Suggested Student Performance Objectives

Open completion of this unit, the student can:

1. Recite at least eight benefits of forest resources to land, human, and economic requirements.
2. Recognize and name six forest products.
3. On a picture, diagram, or model supplied, identify taproot, lateral roots, root hair, trunk, outer bark, inner bark, cambium, sapwood, heartwood, branches, crown, leaves, bud, twigs, flowers, fruit, and seed.
4. Identify by common name _____ important tree species; identify the silvic considerations for each tree species identified; identify the various uses of each tree identified.
5. Prescribe the proper tree species for planting on a given site based upon correct analysis of site conditions and use goals.
6. Plant seedlings without damaging the root system following approved practices for:
   a. Site preparation
   b. Spacing
   c. Stocking rates
   d. Time of planting
7. Prescribe for a specific forest product on a given plantation of any age:
   a. Timing, method, and intensity of next thinning
   b. Timing, method, and intensity of next pruning
   c. Timing and method of weeding
8. Demonstrate the ability to estimate the volume of standing timber on a given tract of land using one approved method, and demonstrate the ability to determine the volume of felled trees, either in cords or in board feet, and to convert from cords to tonnage or weight.
9. List the different governmental and professional forest management organizations and the services they provide the forest landowners.

Unit Outline

I. Introduction
   A. Importance of forestry
      1. Man's dependence on forests
         a. Food
         b. Home
         c. Fuel
         d. Grazing
         e. Recreation
         f. Watershed protection
         g. Protection of soil and wildlife
         h. Jobs
      2. Forest values
         a. Cash products
            1.) Veneer logs
            2.) Sawlogs
            3.) Pulpwood
            4.) Roundwood
            5.) Naval stores
            6.) Christmas trees
            7.) Maple syrup
         b. Aesthetic values
   B. Kinds of forests

II. Tree Identification
  A. Parts of the tree and their function
    1. Roots
      a. Taproot
      b. Lateral root
      c. Root hair
    2. Trunk
      a. Outer bark
      b. Inner bark
      c. Cambium
      d. Sapwood
      e. Heartwood
    3. Crown
      a. Branches
      b. Twigs
      c. Leaves
      d. Buds
      e. Flowers
      f. Fruit
      g. Seed
  B. Distinguishing features
    1. Leaves
    2. Twig and bud
    3. Flowers
    4. Fruit
    5. Seed
    6. Bark
    7. Branching form
  C. Classification
    1. Generic name
    2. Conifers - softwoods
    3. Broadleaf - hardwoods
    4. Monoecious - Dioecious
  D. Identifying important tree species
III. Establishing the Forest
  A. Reproduction
    1. Natural
      a. Selection
      b. Clear cutting in strips
      c. Seed tree cutting
      d. Shelterwood cuttings
      e. Coppice
    2. Artificial
      a. Direct seeding
      b. Planting nursery stock
  B. Purpose of planting
    1. Land stabilization
    2. Watershed
    3. Wildlife
    4. Environmental quality
    5. Economic
  C. Classifying planting site
    1. Soil features
      a. Texture
      b. Color and mottling
      c. Tilth
      d. pH
      e. Slope and aspect
      f. Past treatment
      g. Structure
    2. Physical features
      a. Drainage
      b. Soil depth
      c. Available moisture
      d. Fertility
      e. Planting difficulty
      f. Access
      g. Hazards to survival and early growth
  D. Choosing tree species
    1. Intended use
    2. Site conditions
  E. Obtaining and handling seedlings
    1. Temperature
    2. Keeping roots moist
    3. Heeling-in
  F. Planting methods
    1. Seedings
    2. Seedlings
      a. Hand planting
      b. Mattock
      c. Planting bar
      d. Planting machines
  G. Planning and preparation
    1. Spacing
    2. Stocking rates
    3. Mixed and pure stands
    4. Seasons for planting
    5. Site preparation
      a. Fire
      b. Mechanical means
      c. Chemicals
      d. Bulldozing
      e. Discing
      f. Bedding
IV. Improving the Forest
  A. Weeding
    1. Mechanical
    2. Chemical
  B. Thinning
    1. Methods of selection
      a. Selection system
      b. Row thinning
    2. Pre-commercial and subsequent thinnings
      a. Release cuttings
      b. Improvement cuttings
      c. Chemicals
  C. Pruning
    1. Season
    2. Stand age
    3. Equipment
V. Forest Mensuration
  A. Selecting, adjusting, and operating forest measuring instruments
    1. Biltmore stick
    2. Diameter tape
    3. Tree caliper
    4. Bark gauge
    5. Prism
    6. Increment borer
    7. Abney level
    8. Staff compass
    9. Chain
    10. Log rule
    11. Altimeter
    12. Surveyor's transit
    13. Hand compass
  B. Measuring standing trees
    1. Diameter and height
    2. Form
    3. Value
    4. Defect
    5. Age and growth rate
    6. Use of tree volume tables
  C. Measuring forests
    1. Areas, types, and boundaries
    2. Stand composition, age, and sites
    3. Statistical analysis of sampling methods
    4. Timber cruising
      a. Strip method
      b. Line plot method
      c. Proportional plot
      d. Aerial photographs and check plots

5. Tabulation
6. Valuation of forests and forest crops

VI. Forest Management Services
- A. Federal
  1. U.S. Forest Service
  2. National Park Service
  3. Bureau of Land Management
  4. Bureau of Indian Affairs
- B. State
  1. Forestry service
  2. Extension service
  3. Game and Fish Commission
  4. Private companies
- C. County
  1. Extension forester
  2. County soil conservation service
  3. County extension agent
  4. Private companies
- D. Professional conservation organizations
  1. Society of American Foresters
  2. American Forestry Association
  3. Other
- E. Private forest conservation organizations
  1. American Forest Product Institute
  2. American Pulpwood Association
  3. Technical Association of the Pulp and Paper Industry
- F. Forest research organizations
  1. U.S. Forest Service Experiment Stations
  2. State experiment stations and forests
  3. Research by universities and colleges
  4. Private research

Suggested Learning Activities

1. Discuss and list ways man is dependent on products and services available from forests.
2. On a diagram of a tree, have students label all parts and describe the function of each.
3. Cut and dissect several different species of trees and examine the differences in heartwood, sapwood, cambium, etc.
4. On a field trip, observe different tree species that are present on lowland, upland, swampy areas, etc.
5. Identify all of the important tree species. Use of pressed specimens should be minimized in favor of field identification.
6. On a field trip, observe differences between natural and artificial reforestation.
7. Have students carry out reforestation practices such as planting seedlings, discing, etc.
8. Observe an area being cleared where seedlings are to be transplanted mechanically.
9. Dig soil pits and have students classify a planting site.
10. Observe plantations exhibiting proper and improper selection of tree species.
11. Observe plantations that exhibit results of both use and non-use of proper weeding, pruning, and thinning practices.
12. Dissect trees to show effect of thinning and pruning, on growth rate and quality of plantation trees.
13. Have a resource person demonstrate any measuring practices which may not be practical for students to carry out individually.
14. Determine average age of a plot.
15. Have a resource person, extension forester, game and fish commission representative, etc., discuss purpose and function of his organization and position.
16. Take a field trip to a forest experiment station or research laboratory.

References

Davis. *Forest Management.*
Smith. *The Practice of Silviculture.*
Trier. *Forest Conservation.*
Trier. *Forest Conservation, Growing the Forest.*

Unit

FOREST DISEASE AND PEST CONTROL

Suggested Student Performance Objectives

Upon completion of this unit, the student can:
1. Identify by common name _____ forest insect pests.
2. Locate and identify insect damage in a forest plantation.
3. Identify by common name _____ important tree diseases.
4. Prepare a written report prescribing insect and disease control measures for a given site and forest condition. When pesticides are prescribed, specify chemical used, mixing proportions and elements, quantity, timing of application, and methods of safe and effective handling and application.
5. Recite, in general terms, other major factors of damage in forest plantations, and list the steps to take in prevention and protection.

Unit Outline

I. Forest Insects
- A. Role of insects in the forest
  1. Beneficial insects
  2. Destructive insects
  3. Importance of forest entomology
- B. Forest insect damage
  1. Leaf-eating insects
  2. Inner bark boring insects
  3. Woodboring insects
  4. Sapsucking insects
  5. Tip feeding insects
  6. Root feeding insects
  7. Cone and seed destroying insects
- C. Forest insect pests
  1. Conifer defoliators
  2. Hardwood defoliators
  3. Tip feeders
  4. Sap feeders
  5. Cambium feeders
  6. Heartwood feeders
  7. Disease vectors
  8. Root feeders
  9. Seed destroyers
- D. Insect control measures
  1. Direct control
     a. Mechanical
     b. Biological
     c. Chemical
  2. Indirect control
     a. Biological
     b. Silvicultural practices
     c. Chemical
     d. Statutory regulations
- E. Forest insect legislation

II. Forest Diseases
- A. Major rot-causing fungi
  1. Introduction to and classification of fungi

2. Symptoms and signs of the more important rot-causing fungi
B. Decays, discolorations, and logging wounds in hardwoods
C. Rust, stem, foliage, and root diseases
D. Control and prevention of diseases
1. Principles
2. Methods
3. Costs
4. Effectiveness
5. Agencies involved

III. Other destructive agents
A. Forest animals
B. Natural phenomena
1. Wind
2. Rain
3. Frost
4. Ice
5. Snow
C. Man
1. Logging operations
2. Campers
3. Smokers
4. Hunting and fishing
5. Other
D. Weeds

Suggested Learning Activities

1. Make a field trip to a state, federal or educational research station and survey plots for explanation of the nature of control, evaluation, and experimental work being conducted.
2. Observe insect damage in woods. Locate, capture, and identify forest insect pests.
3. Make a field trip to locate, study, and collect some of the more important rot-causing fungi.
4. Make field dissections of trees with a chain saw to show visible signs and symptoms of decay.
5. Have a resource person from the state or federal plant pest division give a presentation on the state's organization and operational procedures used to combat major tree disease problems.
6. Make a field trip to forest plantations exhibiting protective measures to prevent damage by insects, diseases, man, animals, and/or climatic factors.

References

Anderson. *Forest and Shade Tree Entomology.*
Forbes. *Forestry Handbook.*
Thatcher. *Forest Entomology.*
Trier. *Forest Conservation.*

Unit

FIRE PREVENTION AND CONTROL

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Demonstrate an understanding of the behavior of fire by defining and describing:
a. Fire triangle
b. Radiation
c. Convection
d. Conduction
e. Ignition temperature
2. Compute the fire danger index.
3. Describe the effect of forest fuel size, fuel arrangement, and topography of the area on fire behavior.
4. Use the Osborn Fire-Finder in a given situation to state in degrees and minutes the direction of a hypothetical "smoke" and to report same to within 30 minutes using the vernier scale.
5. Locate on a topographic map, the position of a smoke to within 1/4-mile when given two azimuth readings and tower locations.
6. Identify and state the function of the following fire suppression hand tools and equipment:
a. Fire rake
b. Fire swatter
c. Back-pack pump
d. Drip torch
e. Ax and saw
f. Pulaski
7. State orally or on paper, action required to suppress a fire to 100 percent accuracy when given a fire condition.

Unit Outline

I. Fire Behavior
A. Fire triangle
1. Fuel
2. Oxygen
3. Heat
B. Ignition temperature
C. Sources of heat
1. Direct application of flame
2. Direct application of embers
3. Electrical arcing
4. Friction
5. Spontaneous combustion
D. Heat transfer
1. Radiation
2. Convection
3. Conduction
E. Weather factors
1. Wind
2. Temperature
3. Humidity
F. Forest fuel factors
1. Size of fuel
a. Light fuel
b. Heavy fuel
2. Arrangement
a. Ground or aerial
b. Continuity
c. Compactness
3. Volume
G. Topography
1. Exposure
2. Steepness
3. Canyons - fire behavior
4. Very high elevation

II. Fire Prevention Planning
A. Fire danger rating
1. Fire danger rating system
2. Burning index
3. Build-up index
B. Fire control planning
1. Rate of spread
2. Resistance to control

III. Fire Prevention
A. Reduction of risk
1. Major causes of fire
2. Frequency of occurrences
3. When and where fires are started
4. Why fires occur
B. Prevention methods
1. Understanding, reaching, and influencing people
2. National Cooperative Forest Fire Prevention Campaign
3. Keep Green Program

C. Reduction of hazard
   1. Fire breaks
   2. Area fuel reduction

IV. Presuppression
   A. General fireman's requirements
      1. Physical condition
      2. Personal gear
   B. Fireman's tool and equipment
      1. Fire box
      2. Tool cache
   C. Locating small fires
      1. Aerial patrols
      2. Ground lookouts
      3. Using hand compass
         a. Declination
         b. Azimuth
         c. Back azimuth
   D. Using fire finder
      1. Becoming acquainted with the country
         a. Local landmark reference
         b. Industrial smokes
      2. Locating and identifying smoke
         a. Systematic scan method
         b. Tower records
            1.) Legitimate smoke
            2.) False smoke
            3.) Illegitimate smoke
      3. Smoke location
         a. Leveling fire finder
         b. Orienting fire finder map disk
         c. Caring for fire finder
         d. Measuring angles
         e. Using angles
         f. Intersect method of fixing
         g. Reporting
            1.) Location
            2.) Size
            3.) Smoke drift
            4.) Probable equipment needed

V. Suppression Measurements
   A. Methods and tactics of control
      1. Direct control
      2. Indirect control
   B. Line crew organization
   C. Building the fire line
      1. One lick method
      2. Progressive method
      3. Rotary method
   D. Use of hand tools and equipment
      1. Fire rake
      2. Fire swatter
      3. Shovel
      4. Back-pack pump
      5. Drip torch
      6. Ax and saw
      7. Pulaski
   E. Employing heavy equipment
      1. Dozer
      2. Fire plow
   F. Use of Water
      1. Back pack pumps
      2. Power pumps
      3. Gravity systems
      4. Aerial tankers
   G. Using fire retardants
      1. Water modifications
      2. Retardant chemicals
      3. Uses of foam
      4. Methods of application
         a. Fixed wing aircraft
         b. Helicopter
         c. Ground application

VI. Caring for Tools and Equipment
   A. Replacing handles
      1. Removal of old handle
      2. Wedging
      3. Aligning
      4. Smoothing
   B. Sharpening heads
      1. Ax
      2. Fire rake
      3. Shovel
      4. Pulaski
      5. Fire rake
      6. Other
   C. Preventing rust
   D. Caring for back pack pumps
      1. Metal
      2. Rubber
   E. Maintaining fire hose
      1. Rolling
      2. Storing
      3. Marking ends

Suggested Learning Activities

1. Take a field trip to a forested area and identify natural and man-made fire risks.
2. Practice using the fire danger rating system.
3. Develop a fire plan for a forested area considering the three basic factors of fuel, weather, and topography.
4. Set up a weather station, take readings, and compute the fire danger index.
5. Have a U.S.D.A. Forest Service fire control officer or a state fire control supervisor present fire protection methods.
6. Build a fire line using the different methods and hand tools.
7. Field trip to local, state, or federal area. Observe fire boxes, fire cache and miscellaneous equipment. Have a manager or ranger talk about the station Fire Plan.
8. Practice using the hand compass to find wooded locations.
9. With hand compasses and locations pin pointed on topographic maps, traverse distance.
10. Using guides for fire finder, determine direction and location of hypothetical smoke via Osborn Fire Finder.
11. Practice sharpening fire rakes, shovels, axes, and other fire fighting equipment.
12. Replace handles on shovels, rakes, axes, and other fire fighting tools.
13. Practice rolling, storing, and marking ends of fire hose.
14. Treat fire fighting equipment with a rust inhibitor.

References

U.S.D.A. Forest Service. *Fireman's Handbook.*

U.S.D.A. Forest Service. *Introduction to the Fundamentals of Fire Behavior.*

U.S.D.A. Forest Service. *National Fire–Danger Rating System.*

The units of instruction which follow are basic to the preparation of individuals for entry level employment in land use planning.

BEST COPY AVAILABLE

Figure 5. A planning aide recording information on a map. Planning aides assist planning technicians and urban planners with the preparation of maps in the field and later with refining maps in the office. Courtesy Local Government Research Corporation, State College, Pennsylvania.

Unit

PLANNING AND ZONING

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Outline three steps in the planning process and list the components of a comprehensive plan.
2. Demonstrate proficiency in assembling factual information pertinent to developing a comprehensive plan, correctly read and interpret soil survey maps and land use maps, and utilize information in natural resources plans.
3. Demonstrate the ability to develop with factual information and printed material relating to planning, a comprehensive plan for a township or village, considering:
   a. Transportation and public services
   b. Economic base
   c. Education, cultural and housing facilities
   d. Land use
4. From recall, list eight procedures to follow in implementing a comprehensive plan.
5. Recognize and describe the functions of comprehensive plans and zoning ordiances.

Unit Outline

I. Developing a Comprehensive Plan
   A. Involving direct citizen participation in the planning process.
   B. Components of a comprehensive plan
      1. Plan for economic, civic, and social improvement
      2. Plan for land use
      3. Plan for renewable natural resources
   C. Steps in the planning process
      1. Identifying the community's problems and potentials
      2. Deciding on the community's future wants
      3. Finding practical ways to implement the plan

II. Assembling Factual Information
   A. Economic base, civic and social improvements
      1. Population projections
      2. Existing improvements
      3. Present economic base
      4. The people–their problems and goals
      5. Local government and finance
   B. Soil resources, their use and limitations
      1. General soil maps
      2. Detailed soil surveys
   C. Water resources
      1. Watershed delineation map
      2. Floodplain delineation map
      3. Groundwater map
      4. Maps of present and potential reservoir sites
   D. Present land use
      1. Maps of present land use
      2. Maps of public and private land ownership
   E. Making use of natural resource plans
      1. Information in the regulatory portion of the natural resource plan
         a. Floodplains
         b. Areas unsuitable for septic tanks
         c. Mineral resources
         d. Unsafe areas
         e. Public parks
         f. Extreme slopes
         g. Erosion and sediment control
      2. Information in the advisory portion of the natural resource plan
         a. Soil characteristics
         b. Potential dam sites
         c. Scenic areas
         d. Forest stands and woodlots
         e. Wildlife habitat
         f. Environmental corridors

III. Formulating the Comprehensive Plan
   A. Economic, civic and social improvement plans
      1. Transportation and public services
      2. Economic base

3. Educational, cultural, and housing facilities
4. Government and finance

B. Land use plans
1. Agriculture
a. Agricultural resource data
b. Agriculatural related problems
c. Agricultural problems in suburbia
1.) Farm units damaged
2.) Excessive taxes
3.) Normal farming operations curbed
4.) Convenient agricultural and forestry services denied
2. Industry
3. Business
4. Residences
5. Recreation
6. Forestry
7. Fish and wildlife
8. Water
9. Mining areas

IV. Carrying Out the Comprehensive Plan
A. Informing and involving people
B. Taking formal regulatory measures
1. Adopt the comprehensive plan.
2. Adopt an official map.
3. Proposed capital improvements.
4. Acquire title and/or easement on lands for recreation, scenic values, and for hunting and fishing.
5. Support legislation permitting differential taxation of certain farm, forest, scenic, and open space.
6. Pass a sound subdivision ordinance.
7. Pass a building code.
8. Pass a sanitary code.
9. Pass a good zoning ordinance.

V. Attaining Goals by Zoning
A. Zoning districts
1. Types
a. Farm
b. Residential
c. Planned residential and cluster zones
d. Business
e. Industry
f. Forestry
g. Recreation
h. Floodplain
i. Watershed
j. Conservation
2. Objectives
3. Regulations

B. Zoning administration
1. Zoning administrator
2. Enforcement measures
3. Board of adjustment

Suggested Learning Activities

1. Secure a map of a local township and plot all parcels of land indicating present usage, natural resources, and problem areas.
2. Secure a copy of the SCS soil classification map and plot soil limitations for residential, commercial, road, farm, and recreational areas.
3. Write a complete survey form for surveying the needs and desires of the local people in regard to a comprehensive plan.
4. Collect copies of three other zoning ordinances from other townships and list the major differences.
5. Interview the chairman or a member of the township planning commission and identify the major problem areas of the community. Determine the present plans for solving these problems.
6. Choose one resource area within the comprehensive plan and write a proposed zoning ordinance or plan for solving that problem. Use other ordinances as guides.
7. Make a sketch plan of a well-planned subdivision for a new residential development and include regulations.
8. Take a field trip to a local building under construction and note the poor areas of construction. Secure copies of building codes from other areas and outline the major needs for your township.
9. Invite a building code township planner, or regional planner to speak to the class.

References

Munzer. *Planning Our Town.*

Soil Conservation Society of America. *Planning and Zoning for Better Resource Use.*

Soil Science Society of America and Agronomy Society of Agronomy. Soil Surveys and Land Use Planning.

Unit

LAND MEASUREMENT

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Obtain distance by packing on a level field within variation of two feet per 100 feet.
2. Obtain distance with a steel tape on sloping terrain (over 2%) using a plumb bob (allowable error–one foot per 500 feet).
3. Establish a predetermined angle of declination on a surveyor's staff compass to within one degree.
4. Follow a straight line of a predetermined tree bearing, with a surveyor's staff compass in a forested area (allowable error–one foot per 300 feet).
5. Explain magnetic declination and its importance in land measurement.
6. Give legal descriptions of selected plots of land.
7. Lay out a perpendicular line on the ground, from a base line stablished at each end with a wooden stake and tack and shall not deviate from a tripod level reading by more than one inch per 40 feet of perpendicular line.
8. Determine field area, in acres, on assignment sheets using a guide set of sample problems and formulas of:
a. rectangle
b. right triangle
c. any triangle
d. trapezoid
e. curved boundary
f. Trapezium
9. Run an open traverse with the surveyor's staff compass.
10. Close a traverse in the field using a surveyor's staff compass and steel chain and predetermined true bearings and distances. (Traverse is to close within one foot per 500 feet of distance.)

Unit Outline

I. Methods of Linear Measurement
A. Pacing
1. Standardizing stride
2. Level versus uneven terrain
3. Ease of application
4. Place of application

B. Steeltape
1. Major units of measure
a. Feet and fractions
b. Chains and links
2. Parts and use
a. Thong
b. Trailer
c. Use

3. Care of tape
   a. Cleaning and oiling
   b. Reel storage
   c. Dragging

II. Using a Compass
   A. Angle of declination
      1. True North
      2. Magnetic North
      3. Arrows on topographic map
         a. True North
         b. Magnetic North—degrees of declination
   B. Parts of compass
      1. Compass box
         a. Graduated circle
         b. N-S reference points
         c. Interchanged E-W points
         d. North arrow
         e. Leveling bubble
         f. Stop lock
         g. Sight vanes
      2. Vertical spindle
      3. Leveling head
      4. Jacob staff
   C. Setting off angle of declination
   D. Magnetic declination and land measurement
      1. Quadrants
         a. NE, NW, SE, SW
         b. North and South reference points
      2. Degrees and minutes
      3. Writing bearings
         a. Direction
         b. Degrees and minutes

III. Public Land Surveys
   A. Metes and bounds
   B. Rectangular system of public land survey
      1. Principal meridian
      2. Base line
      3. Range lines
      4. Township lines
      5. Sections
      6. Subdivisions of sections
   C. Legal descriptions

IV. Laying Out Perpendicular Lines
   A. Crew set-up
      1. Head tapeman (chainman)
      2. Rear tapeman (chainman)
   B. Equipment needed and its use
      1. Steel tape and reel
      2. Plumb bob
      3. Ring and 11 pins
      4. Range pole
      5. Small stakes
   C. Procedure for steel taping on land less than 2 percent slope
      1. Reel storage
      2. Dragging by thong
      3. Job assignments of rear and head tapemen
      4. Verbal working instructions
         a. chain
         b. stick
      5. Distances not in even feet or chains
   D. Procedure for steel taping on land sloping more than 2 percent
      1. Breaking chain
      2. Using plumb bob
      3. Using range poles
   E. Measuring angles
      1. Three-four-five method
      2. Chold method

V. Determining Land Area
   A. Practical application
      1. Use in complete surveys
      2. Use with planetable
   B. Calculation of tape areas
      1. Rectangle
      2. Right triangle
      3. Any triangle
      4. Trapezoid
      5. Curved boundary
      6. Trapezium

VI. Traverse Methods of Measurement
   A. Open traverse
      1. Simple traverse note form
         a. Station
         b. Object (adjacent station)
         c. Distance
         d. True bearing
      2. Combination of steel taping and compass readings
      3. Crew make-up and responsibility
         a. Instrument man
         b. Recorder
         c. Head chainman
         d. Rear chainman
   B. Closed traverse

Suggested Learning Activities

1. Practice pacing and chaining a four-sided figure on level ground.
2. Determine number of paces per 100 feet.
3. Practice using the tape, cleaning it, and returning it to the reel.
4. Take point on topographic map and select a destination point. Attach string to pin at point and extend along a true North direction. Attach another string and extend along a magnetic North direction. Have students calculate distance by which they would have missed proposed destination if they had followed magnetic North without allowing for the angle of declination.
5. Practice using the staff compass to follow a true bearing.
6. Practice measuring distances on terrain of less than 2 percent slope.
7. Pick a traverse of known distance on sloping terrain of over 2 percent and determine distance by breaking chain when necessary.
8. Erect a perpendicular by the 3-4-5 method and stake it out.
9. Practice determining acreages on given problems.
10. Practice using the staff compass to run and measure straight lines at prescribed bearings.
11. Run a series of open traverses at different true bearings to a closed traverse conclusion.
12. Practice giving legal descriptions of selected plots of land.

References

Davis and Kelly. *Short Course in Surveying.*
Schwab and others. *Elementary Soil and Water Engineering.*

Adapted from "Land Measurement," No. 01.0603-04, a module of instruction prepared by Bureau of Agricultural Education, State Education Department, Albany, New York 12224.

Unit

SURVEYING

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Use stadia in the field for determining horizontal distances to the nearest one tenth foot per 100 feet of distance.

2. Graphically plot given bearings and distances that form a closed traverse to within one foot of closure per 100 feet of distance.
3. Use quickline note forms to record (in the field) and calculate (in the classroom) stadia data to within one tenth foot in 100 feet of horizontal distance.
4. Establish (in the field) a base line with the plane table (traverse board) set up at either end and oriented for field mapping to within one degree of error and no error in vial bubble.
5. Draw a map using a plane table (traverse board) that plots interior detail within an average of one scaled foot per five plotted structures when compared to "master" overlay.
6. Adjust a pantograph to function properly in determining a scale requested by the instructor.
7. Calculate the acreage of a plotted closure with a dot grid to within an allowable error of one acre per twenty acres.
8. Given drafting instruments, describe techniques to prepare a finished map that demonstrates map parts, mechanical lettering, line differentiation, and neatness to instructor's standards and then perform the procedure.

Unit Outline

I. Stadia Distances
   A. Stadia principle
      1. Geometric
      2. Constant factor
   B. Reading the rod
      1. Horizontal readings
      2. Sloping readings
   C. Linear measurement
      1. Note form for horizontal readings
      2. Running lines
   D. Sources of error
II. Stadia Traverse Closure
   A. Compass bearings
   B. Linear measurement
   C. Traverse (closed) plotting
      1. North orientation
      2. Protractor use
      3. Engineers scale
      4. Drafting board and T square
   D. Relativity to map preparation
III. Field Note Taking
   A. Forms of notes
      1. Variance
      2. Interpretation
   B. Notebook
      1. Supplemental sketches
      2. Proper procedure
      3. Importance of accuracy
IV. Plane Table Survey
   A. Parts and use
      1. Alidade and scope
      2. Table and level
      3. Setting up
   B. Variations
      1. Traverse board
      2. Sighting devices
   C. Application
      1. Accuracy
      2. Area mapping
      3. Traverse interior detail
      4. Topographic use
      5. Land use planning
   D. Methods
      1. Intersection
      2. Radiation
      3. Traversing
V. Maps and Mapping
   A. Interpreting maps
      1. Aerial photos
      2. U.S.Geological Survey Topographic maps
   B. Using mapping instruments
      1. Lettering
         a. Sets
         b. India ink
         c. Styles
      2. Pantograph
         a. Enlargement
         b. Reduction
         c. Duplication
      3. Determining acreage
         a. Dot grid
         b. Planimeter
         c. Summation of squares
   C. Map drafting
      1. Drawing instruments
      2. Map requirements
         a. Title
         b. Scale
         c. Meridian
            1.) True
            2.) Magnetic
         d. Name and date
         e. Border
         f. Legend
      3. Inking
         a. Line width
         b. Ruling
         c. Shading
         d. Colored inks
         e. Proportion
         f. Cleaning

Suggested Learning Activities

1. Determine a distance along a property line using stadia.
2. Collect linear measurement along known bearings of a closed traverse and plot on paper the closed traverse to a predetermined scale.
3. Map the school area. If possible, utilize property corners to check closure accuracy. Include all interior detail.
4. With a map such as the one developed in activity C, use a pantograph to change the map scale.
5. Use a dot grid and calculate the approximate acreage of the map prepared in activity C.
6. Prepare an inked map complete with all general requirements.

References

Davis and Kelly. *Short Course in Surveying.*
Schwab and others. *Elementary Soil and Water Engineering.*

Adapted from "Advanced Surveying," No. 01.0603-05, a module of instruction prepared by Bureau of Agricultural Education, State Education Department, Albany, New York 12224.

BEST COPY AVAILABLE

The units of instruction which follow are basic to the preparation of individuals for entry level employment related to the management of mineral and mineral fuel resources.

Figure 6. Mining area restoration workers mulching a strip mine spoil bank to establish ground cover.

Unit

MINERAL AND MINERAL FUEL RESOURCES

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Correctly identify _____ rocks and _____ minerals common to the state.
2. Given samples of rock, the student can classify each as igneous, sedimentary, or metamorphic.
3. Briefly describe the formation of coal in the earth's crust.
4. List and give a function of three or more minerals in each of the following categories:
   a. Energy fuels
   b. Iron alloys
   c. Nonferrous metals
   d. Construction minerals
   e. Chemical and industrial minerals
5. Demonstrate an awareness of the importance of geological science in mining by briefly describing how a knowledge of geological science is used in predicting location of mineral deposits and using mining strata control.

Unit Outline

I. Rocks
   A. Types
      1. Igneous
      2. Sedimentary
      3. Metamorphic
   B. Conditions causing certain deposits
   C. Effects of weathering
      1. Wind
      2. Water
      3. Atmosphere
      4. Ice
   D. Identifying common rocks
      1. Texture
      2. Mineral composition
      3. Other properties
II. Mountain Formation
   A. Shrinking of the sphere
   B. Faulting
   C. Anticlines and synclines
   D. Redepositing of weathered material
III. Minerals
   A. Formation of mineral deposits
      1. Concentrating
      2. Intrusion
      3. Growth deposits
      4. Ocean floor deposits
   B. Identifying common minerals
      1. Physical properties
         a. Form
         b. Cleavage and fracture
         c. Color
         d. Streak
         e. Luster
         f. Hardness
         g. Specific gravity

2. Chemical composition

IV. Types of Mineral Resources
- A. Energy fuels
  - 1. Coal
    - a. Origin
    - b. Occurrence
    - c. Distribution
    - d. Reserves
  - 2. Petroleum
    - a. Origin
    - b. Occurrence
    - c. Distribution
    - d. Reserves
- B. Iron
- C. Iron alloys
  - 1. Manganese
  - 2. Chromium
  - 3. Nickel
  - 4. Molybdenum
  - 5. Tungsten
  - 6. Vanadium
  - 7. Aluminum
  - 8. Titanium
- D. Nonferrous metals
  - 1. Copper
  - 2. Lead
  - 3. Zinc
  - 4. Tin
- E. Construction minerals
  - 1. Asbestos
  - 2. Asphalt
  - 3. Cement
  - 4. Clays
  - 5. Sand and gravel
  - 6. Gypsum
  - 7. Lime
  - 8. Slate
  - 9. Stone
- F. Chemical and industrial minerals and metals
  - 1. Antimony
  - 2. Arsenic
  - 3. Bismuth
  - 4. Cadmium
  - 5. Cobalt
  - 6. Mercury
  - 7. Platinum
  - 8. Silver
  - 9. Barite
  - 10. Cryolite
  - 11. Fluorspar
  - 12. Feldspar
  - 13. Mica
  - 14. Potash
  - 15. Phosphate rock
  - 16. Pyrites
  - 17. Sulfur
  - 18. Salts

V. Use of Geological Sciences
- A. Prediction of likely location of mineral deposits
- B. Aid in mining strata control

Suggested Learning Activities

1. Make a collection of rocks.
2. Make a collection of metallic and nonmetallic minerals.
3. Make a collection of coals.
4. Make a collection of petroleum products.
5. Determine what minerals are included in your state's resources and the number of workers employed in mineral extraction and related industries.
6. Study your state laws relating to the mining of minerals and mineral fuels.

References

Fagan. *View of the Earth - An Introduction to Geology.*
Gallant and Schuberth. *Discovering Rocks and Minerals.*
Longwell and Flint. *Introduction to Physical Geology.*
National Coal Association. *Coal.*
Snelgrave. *Opportunities in Geology and Geological Engineering.*

Unit

INTRODUCTORY MINING

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Demonstrate an awareness of the impact of mining on the environment by describing the importance of:
   - a. Conserving and stretching the limited mineral and fuel resources
   - b. Returning mined land to its original contour and landscape
   - c. Turning mineral wastes into usable products
2. Demonstrate an understanding of mining terminology by correctly defining 16 out of the 18 mining terms studied.
3. List and explain the main provisions of mining laws relative to claims, size of claims, marking claims, and mineral rights.
4. Demonstrate the ability to design a plan for surface mining a given product on a given area of land, employing mining and processing methods that result in the least waste and the maximum protection of the unmined portion of the mineral deposits.
5. Identify main crosscut, outlet crosscut, auxiliary crosscuts, tunnels, traverse galleries, vertical shafts and main haulageways on a picture or diagram of an underground mine.
6. List and explain the main provisions of federal and state laws relating to the miner's health and safety.

Unit Outline

I. Introduction
- A. Mining
  - 1. Surface
  - 2. Underground
  - 3. Environmental impact
- B. Materials mined
  - 1. Mineral fuels
  - 2. Iron and iron alloys
  - 3. Nonferrous metals
  - 4. Construction minerals
  - 5. Chemical and industrial minerals and metals
- C. Becoming familiar with mining terms
  - 1. Mining
  - 2. Prospecting
  - 3. Exploration
  - 4. Exploitation
  - 5. Vein
  - 6. Shoot
  - 7. Bedded deposit
  - 8. Masses
  - 9. Outcrop
  - 10. Strike
  - 11. Drifts
  - 12. Level

13. Crosscuts
14. Winze
15. Raise
16. Shaft
17. Hanging wall
18. Footwall

II. Exploration
- A. Prospecting
  1. Purpose and importance
  2. Geological
  3. Geophysical
  4. Geochemical
- B. Exploration drilling
- C. Ore formation and geologic influence

III. Mining Law
- A. Claims
  1. Discovery
  2. Size of claim
  3. Marking the location
- B. Mineral rights
- C. Compliance with state and federal laws
- D. Health and safety hazards

IV. Surface Mining
- A. Pit planning and layout
- B. Stripping the land
- C. Production engineering
  1. Drilling
  2. Blasting
  3. Loading
  4. Hauling
- D. Safety practices
- E. Land reclamation

V. Opening Up Underground Mines
- A. Crosscuts
  1. Main crosscut
  2. Outlet crosscut
  3. Auxiliary crosscuts
- B. Tunnels (adits)
- C. Traverse Galleries
- D. Vertical shafts
  1. Working shafts
  2. Downcast or upcast shafts
  3. Underground shafts
- E. Main haulageways
- F. Preventing the settling of ground
- G. Controlling underground fires

VI. Underground Mines
- A. Coal
- B. Gypsum
- C. Salt
- D. Nickel
- E. Iron
- F. Copper
- G. Lead
- H. Zinc
- I. Uranium

Suggested Learning Activities

1. Take a field trip to a surface mining operation and observe conservation methods used.
2. Interview miners and have them relate conservation practices employed in underground mines.
3. Write your state's department of mines or geology and inquire about provisions being made for conserving minerals.
4. Interview geologists and have them relate their activities in mineral exploration.
5. Make a list of new uses of minerals not common 50 years ago, which account in part for the increased consumption which has taken place since 1920.

References

Lewis and Clark. *Elements of Mining.*
National Coal Association. *Coal.*
Pfleider. *Surface Mining.*
U.S. Department of the Interior. *Surface Mining and Our Environment.*

Unit

MINING AREA RESTORATION

Suggested Student Performance Objectives

Upon completion of this unit, the student can:
1. Carry out an effective inventory of a surface mined area determining texture, acidity, and slope of spoil banks, erosion, plant cover, water quality, streamflow, location of fires, and other hazards.
2. Utilizing the data collected in the inventory as well as regional plans, governmental law codes, and a review of governmental and private assistance programs, determine an appropriate future use for the area.
3. Prepare a written report outlining steps in the basic reclamation of an area for a given use.
4. List the goals of a national surface-mined-land conservation effort.

Unit Outline

I. Characteristics and Physical Condition of Mined Land
- A. Spoil banks
  1. Texture
  2. Acidity
  3. Slopes
- B. Climate
- C. Erosion
  1. Slides
  2. Access roads
- D. Plant cover
- E. Water quality and streamflow
- F. Ponds
- G. Effect on wildlife
- H. Fire
  1. Coal refuse banks
  2. Underground mine fires
- I. Land and property devastation

II. Adapting Reclamation to Site
- A. Agricultural use
  1. Cultivated crops
  2. Grass and pasture
- B. Forests and rangeland
- C. Recreation

III. Steps in Basic Reclamation
- A. Grading
- B. Planting
- C. Controlling drainage
  1. Direction of diversion ditches
  2. Acidity
- D. Repairing slide damage
- E. Repairing haul roads
- F. Repairing stream channels
- G. Stabilizing ponds
- H. Other hazardous conditions

IV. The Law and Surface Mining
- A. Federal
  1. Mineral Leasing Act

2. Mineral Leasing Act for Acquired Lands
3. Indian Lands

B. State
1. State control of mining on state, county, or municipally owned lands
2. State control of mining on private lands
3. Other controls

C. Local control of mining on private lands

D. Water pollution controls

E. Regulations concerning reclamation
1. Lakes created
2. Type of material in the overburden
3. Use being made of adjoining lands

V. Conservation Effort

A. Industry

B. Federal government

C. State governments

D. Areas of research on surface-mined-land
1. Revegetation
2. Chemistry of overburden and spoils
3. Hydrology
4. Earth movement and placement
5. Haul roads
6. Land use potential

E. Goals of a national surface-mined-land conservation effort
1. Preplanning
2. Stabilization
3. Storm water control
4. Water quality
5. Water storage
6. Air quality
7. Natural beauty
8. Health and safety

Suggested Learning Activities

1. Take a field trip to a strip mining operation and observe the conservation measures being taken.
2. Take a field trip to a mine drainage treatment facility.
3. Inventory a mined area and propose a future use for the land.
4. Outline steps for reclaiming a mined area for a given use.
5. Interview employees of the Soil Conservation Service and Forest Service and determine what services their respective organizations are providing in the area of mined land reclamation.

References

Pfleider. *Surface Mining.*

U.S. Department of Agriculture. *Restoring Surface-Mined Land.*

U.S. Department of the Interior. *Surface Mining and Our Environment.*

BEST COPY AVAILABLE

The units of instruction which follow are basic to the preparation of individuals for entry level employment in rangeland management.

Figure 7. Range aides building fence on the West Fork range allotment in Montana. Courtesy U.S. Forest Service.

Unit

RANGE SCIENCE

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Recite at least four benefits of range crops to land, wildlife, livestock, recreation, and economic requirements.
2. Recognize and describe three factors affecting the productivity of a given range land.
3. Identify by common name _____ important range plant species.
4. Identify the ecological considerations for each species identified.
5. Identify various use values of each species identified.

Unit Outline

I. Range Plants
   - A. Types
     1. Grasses
     2. Forbs
     3. Shrubs
     4. Trees
   - B. Identification of common range plants.
     1. Parts
        - a. Roots
        - b. Leaves
        - c. Stems
        - d. Flowers
        - e. Fruits
        - f. Seeds
     2. Growth habits
        - a. Annual
        - b. Biennial
        - c. Perennial
        - d. Stage of maturity
        - e. Location
          - 1.) Soils
          - 2.) Elevation
          - 3.) Water
          - 4.) Salinity
     3. Poisonous or non-poisonous

II. Productivity of Range
   - A. Size and quantity
   - B. Quality
     1. Palatability
     2. Nutritive value
     3. Stage of growth in relation to grazing
   - C. Effects of grazing
     1. Carrying capacity
     2. Stability of range plants under grazing conditions
     3. Evaluation of range conditions

III. Benefits of Range Crops
   - A. Forage values
     1. Season of best use
     2. Comparative nutritional values of plants
   - B. Influence on water resources
     1. Consumptive use by plants
     2. Conservation value
   - C. Dependability (consistency of production)

Suggested Learning Activities

1. Observe and identify plants under range conditions. Recognize the different characteristics of specified species.
2. Prepare personal plant identification specimens.
3. Identify the parts of the plant and the function of each part.

4. On a field trip, observe the production and use of range crops.
5. Evaluate the quantity and quality of a given rangeland area.

References

Ensminger. *The Stockman's Handbook.*
Humphrey. *Range Ecology.*
Phillips Petroleum Co. *Pasture and Range Plants.*
Sampson. *Range Management, Principles and Practices.*
Stoddard and Smith. *Range Management.*

Unit

RANGE MANAGEMENT

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Evaluate a specific rangeland situation, identify any abnormal conditions, and determine the carrying capacity of the area.
2. Develop a complete written rangeland management plan for a given area, considering:
   a. Carrying capacity
   b. Livestock watering areas
   c. Livestock salting areas
   d. Fencing
   e. Trail improvement
   f. Rotation and deferred grazing
   g. Clearing
   h. Reseeding
   i. Fertilizing
   j. Insect and disease control
   k. Weed control
   l. Fire protection and controlled burning
   m. Watershed relations
3. Demonstrate the ability to utilize services available from the conservation agencies in the county or district.

Unit Outline

I. Determining Range Conditions
   A. Basis for judging range conditions
      1. Capabilities
      2. Abnormal conditions
         a. Fire
         b. Floods
         c. Drought
         d. Insects
         e. Plant disease
         f. Weeds
         g. Overgrazing
   B. Determining trends in range condition
      1. Vegetation surveys
      2. Changes in wildlife and livestock population

II. Range Use Practices
   A. Controlled grazing
      1. Developing water areas
      2. Salting
      3. Fencing
      4. Rotation grazing
      5. Deferred grazing
      6. Numbers of animals
      7. Kinds of livestock and wildlife
      8. Riding
      9. Trail improvement
   B. Clearing land
      1. Chain
      2. Chemical
      3. Controlled burning
      4. Plowing
      5. Other
   C. Reseeding
      1. Seedbed preparation
      2. Methods of planting
   D. Fertilizing
      1. Methods of application
      2. Kinds and amounts
      3. Conditions

III. Management Services Available
   A. Federal
      1. United States Forest Service
      2. Bureau of Land Management
      3. U.S. Soil Conservation Service
      4. Agricultural Stabilization and Conservation Service
   B. State
      1. Department of Natural or Environmental Resources
      2. Department of Forestry
      3. Fish and Wildlife Commission
   C. District and County

Suggested Learning Activities

1. Take field trip to rangelands exhibiting damage and/or protective measures to prevent damage by fire, insects, and disease.
2. Distinguish between desirable and undesirable plant species that may invade a range.
3. Provide work experience in mechanical and chemical clearing, controlled burning, fertilizing and seeding rangeland crops.
4. Cruise rangeland areas and judge range conditions.
5. Practice determining the carrying capacity of selected range areas.

References

Donahue. *Our Soils and Their Management.*
Ensminger. *The Stockman's Handbook.*
Humphrey. *Range Ecology.*
Phillips Petroleum Co. *Pasture and Range Plants.*
Sampson. *Range Management, Principles and Practices.*
Stoddard and Smith. *Range Measurement.*

BEST COPY AVAILABLE

The units of instruction which follow are basic to the preparation of individuals for entry level employment in outdoor recreation.

Figure 8. A campground caretaker painting a service building. Courtesy Shawnee State Park, Schellsburg, Pennsylvania.

Unit

RECREATIONAL USE OF NATURAL RESOURCES

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Recognize and list the various demands by the public for different types of outdoor recreation experiences.
2. Recognize and list the different types of natural resource recreational areas and the kinds of services and facilities required for each.
3. Recognize the income potential from various types of recreational enterprises and supplementary sources of income.
4. Carry out an effective inventory of the recreational enterprises in a given area. With inventory data and printed material, proposed additional outdoor recreation enterprises, considering:
   a. Location of enterprises
   b. Types of facilities
   c. Cultural treatment of vegetation

Unit Outline

I. Demand for Recreation
   A. The emergence of leisure
   B. Effects of leisure on society
   C. Effects of leisure on the individual
   D. Leisure, recreation, and work
   E. Importance of recreation to the community
   F. Outdoor recreation in American life
      1. Definition of outdoor recreation
      2. Need for outdoor recreation
         a. Removal of man from natural heritage
         b. Need to restore balance
         c. Others
   G. Extent of outdoor recreation in America

II. Kinds of Outdoor Recreational Enterprises
   A. Fishing areas
   B. Hunting areas
   C. Shooting areas
   D. Scenic, historic and natural areas
   E. Camping areas and cabin sites
   F. Picnic areas
   G. Swimming areas
   H. Winter sports areas
      1. Skiing
      2. Skating
      3. Snowmobiling

III. Sources of Supplemental Income
   A. Bait and tackle sales
   B. guide services
   C. Lodge, snack bars, concessions
   D. Ski lessons
   E. Rentals
      1. Boats
      2. Fishing tackle
      3. Snowmobiles
      4. Skates
      5. Skiing equipment
      6. Fishing areas
      7. Kennels
      8. Horses
      9. Other

IV. Exploring Opportunities for Establishing a Recreational Enterprise
   A. Survey available outdoor recreational facilities within the region
      1. National parks and forests
      2. State parks and forests
      3. Private enterprises
   B. Determine need for additional outdoor recreation enterprises

C. Investigating possibilities of a selected area for recreational enterprises
   1. Location
      a. Accessibility
      b. Population centers
   2. Year around or seasonal enterprises
   3. Land
   4. Forests
   5. Water
   6. Wildlife
   7. Structures

Suggested Learning Activities

1. Make a field trip to study the facilities and managerial aspects of a national park.
2. Make a field trip to study the facilities and managerial aspects of a state park.
3. Make a field trip to several private outdoor recreational enterprises such as campgrounds, shooting preserves, fishing areas, and winter sports areas.
4. Survey available outdoor recreation facilities within the school district.
5. Survey recreational needs in an area.
6. Inventory the school district or region to determine what possibilities exist for a recreational enterprise.
7. Inventory a given piece of land and propose the development of a recreational enterprise on it.

References

Brockman. *Recreational Use of Wild Land.*
Douglass. *Forest Recreation*
Jensen, C. R. *Outdoor Recreation in America.*
U.S.D.A. Farmer's Home Administration *Handbook of Outdoor Recreation Enterprises in Rural Areas.*

Unit

NATURAL RESOURCE RECREATIONAL BUSINESS ASPECTS

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Recognize and demonstrate basic bookkeeping procedures, define bookkeeping terms.
2. Demonstrate by response to written and oral questions, a knowledge of the importance of bookkeeping.
3. Recognize and effectively meet the recreational enterprise operator's personal responsibilities regarding liability, property, and compensation insurance.
4. Outline a safety program for a given recreational enterprise.
5. Recognize and effectively satisfy all local, state, and federal laws pertaining to a given recreational enterprise.
6. Know and effectively utilize the financial and technical assistance of federal, state, and local agencies in the development of a recreational enterprise.
7. List the basic provisions of legislation of importance to workers including social security, workman's compensation, and minimum wage.
8. List the provisions relating to taxes of concern to workers including federal income taxes, social security taxes, federal use tax, state permits, etc.
9. Utilize modern advertising methods to promote a recreational area effectively. Design a brochure for a given recreational enterprise.

Unit Outline

I. Business Aspects of Recreational Enterprises
   A. Business procedures
   B. Record keeping
   C. Tax assessment and structure
   D. Public relations with:
      1. Customers
      2. Community
   E. Legal restrictions
      1. Zoning regulations
      2. Water and sanitation regulations
      3. Fire regulations
      4. Law enforcement regulations
      5. Wild game regulations

II. Need for an Insurance Program
   A. Kinds needed
      1. Liability
      2. Accident
      3. Compensation
      4. Collision
      5. Theft
      6. Fire
   B. Determining amounts needed
   C. Obtaining insurance

III. Establishing a Safety Program
   A. Boat safety
   B. Hunting safety
   C. Swimming safety
   D. Ice, snow, snowmobile, and skiing safety
   E. Hiking safety
   F. Fire safety
   G. Riding safety

IV. Financial Assistance for Recreational Development
   A. Farmer's Home Administration
   B. Production Credit Administration
   C. Commercial Banks
   D. Small Business Administration
   E. Agricultural Stabilization and Conservation Service

V. Technical Assistance
   A. State Department of Parks and Recreation
   B. Bureau of Outdoor Recreation
   C. Soil Conservation Service
   D. Forest Service
   E. Cooperative Extension Service
   F. Rural area development

VI. Maintaining and Operating the Enterprise
   A. Sanitation
      1. Sewage
      2. Refuse disposal
      3. Vermin control
   B. Water supply
   C. Electric supply
   D. Vegetation control
   E. Controlling insects
   F. Area safety

VII. Administration of the Enterprise
   A. Employee relations
      1. Compensation
         a. Salaries
         b. Social Security tax
         c. Workman's Compensation
         d. Federal Income tax
      2. Attitude and goodwill of employees
      3. In-service training of employees
   B. Customer relations
      1. Registering of guests
      2. Hospitality
   C. Fee collection
      1. Manual

2. Mechanical
   a. Coin operated gates
   b. Ticket vending machines

D. Signs
   1. Designing signs
      a. Administrative
      b. Directional
      c. Restrictive
      d. Interpretive
   2. Maintaining signs

Suggested Learning Activities

1. Design a brochure for a campground.
2. Write advertising copy for an outdoor recreational enterprise.
3. View a recreational enterprise and discuss management procedures with the owner.
4. Review the management requirements of an established recreational enterprise, paying particular attention to legal restrictions dictated by the local government.
5. Discuss with a representative of Farmer's Home Administration the financial assistance available for developing a recreational area.
6. Discuss the potential risks and liabilities associated with the operation of a recreational area.
7. Prepare a workable plan for the maintenance of a developed campground or picnic area, including:
   1. Upkeep of the facilities
   2. Provision of services
   3. Maintenance of roads and trails
   4. Maintenance of vegetation
   5. Reduction of all forms of hazards
8. Have insurance representatives discuss the kinds and amount of insurance needed for a recreational enterprise and methods of acquiring the insurance.
9. Invite resource people - lawyers, wildlife officers, social security and income tax experts - to speak to the group.

References

Douglass. *Forest Recreation.*

U.S.D.A. Forest Service. *Forest Recreation for Profit.*

U.S.D.A. Farmer's Home Administration. *Handbook of Outdoor Recreation Enterprises in Rural Areas.*

Unit

DEVELOPMENT OF SUMMER RECREATION AREAS

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Utilize maps, regional plans, governmental law codes, labor department statistics, review of governmental and private assistance programs; review external factors of travel time, proximity to demand, type of demand, state and local laws and regulations, competition, financing, etc., in selecting a site for a summer recreational area.
2. Recognize internal factors of physical features of the site, presence of natural attractions, expansion area, ease of access, water supply, vegetation, etc., in selecting a site for a recreational area.
3. Carry out an effective inventory of a proposed recreation area through preparation of survey, maps of boundaries, contours, water and vegetation features, and existing cultural developments; prepare a written report summarizing natural hazards existing on the site, recommended development of water resources, recommended campsite and sanitation facilities locations, natural features of interest, recommended access to the site, recommended road layout within the area, and suggested recreation activities that the site may be developed to accommodate.
4. Demonstrate ability to develop, with inventory data and printed material relating to campground facilities and layout specifications, a workable campground site design, considering:
   a. Carrying capacity of the site
   b. Types of facilities
   c. Design of all roads, buildings, campsites, water, sewage facilities, trails, platforms, fireplaces, rubbish disposal facilities, benches, stables, safety regulation devices, signing and lighting.
   d. Design of all cultural treatment of vegetation including landscaping, removal of hazardous vegetation, scenic vistas, barriers, lawns, and erosion control
5. Demonstrate ability to develop a workable plan for the maintenance of a developed recreation area including:
   a. Upkeep of facilities
   b. Provision of services
   c. Maintenance of roads and trails
   d. Maintenance of vegetation
   e. Reduction of all forms of hazards to promote safety

Unit Outline

I. Developing Campgrounds and Picnic Areas
   A. Providing for safety and sanitation needs
      1. Water supply
         a. Requirements
         b. Sources
         c. Treatment
         d. Distribution
      2. Sanitation
         a. Sewage disposal
            1.) Water carriage systems
            2.) Subsurface disposal systems
            3.) Surface disposal systems
         b. Garbage
            1.) Collection
            2.) Disposal
   B. Selecting a site for a campground
      1. Physical features
         a. Water
         b. Topography
         c. Potable water
         d. Vegetation
         e. Natural attractions
         f. Forest pests
         g. Animal and bird life
      2. Socioeconomic factors
         a. Geographic location
         b. Economic and business management
         c. Proposed campground facilities
   C. Laying out the campground
      1. Locating camp sites
         a. Tent sites
         b. Trailer sites
         c. Parking areas
         d. Picnic tables
         e. Fireplaces
      2. Locating roads
      3. Locating improvements
         a. Sanitation facilities
         b. Potable water facilities
         c. Barriers and entrance gates
         d. Directional signs

e. Trails and paths
f. Other buildings

4. Developing supplemental enterprises
a. Camp stores
b. Concessions
c. Equipment rental
d. Horse rentals
e. Firewood

D. Laying out the picnic area
1. Locating picnic areas
a. General use picnic grounds
b. Group picnic grounds
c. Roadside picnic grounds
2. Locating roads
3. Locating improvements
a. Sanitation facilities
b. Potable water facilities
c. Barriers and entrance gates
d. Directional signs
e. Trails and paths

II. Developing Water-oriented Recreational Enterprises
A. Swimming
1. Selecting a swimming site
2. Developing the beach area
a. Slope
b. Composition
c. Privacy
3. Providing for safety
a. Quality of water
b. Physical hazards
c. Safety equipment
d. Health requirements
4. Developing supporting facilities
a. Sanitation facilities
b. Drinking facilities
c. Dressing facilities
d. Parking facilities
5. Developing supplemental facilities
a. Play fields
b. Concession stands
c. Picnic areas

B. Marinas
1. Selecting points of access
2. Developing a boat landing area
a. Launching ramp
b. Approach road
c. Parking
d. Water and sanitation
3. Developing supplemental enterprises
a. Boat rentals
b. Boat storage
c. Marine service center

C. Fishing resorts
1. Planning a fishing camp
a. Location
b. Types of cabins
c. Picnic areas
d. Administration - management
2. Developing fishing areas
a. Docks
b. Boat launches
c. Bait and tackle facilities
3. Sources of supplemental income
a. Marine supplies and fishing tackle
b. Concessions
c. Bait
d. Fishing fees and licenses
e. Renting tackle

III. Planning hiking and Riding Trails
A. Location
1. Scenery
2. Grade
B. Marking and clearing
C. Bridging
D. Rest areas

IV. Planning and Operating a Hunting Preserve
A. General features
B. Special features
1. Skeet range
2. Picnic areas
3. Rifle and pistol area
4. Archery range
C. Hunting and trapping fees
D. Hunting and trapping rights
1. Limits
2. Laws
3. Seasons
4. Banding
E. Hunting and trapping services
1. Guides for hunting
2. Leasing for hunting
3. Providing boats
4. Providing horses
5. Do rental

V. Planning and Operating a Riding Stable
A. Horses and riding equipment
1. Types and kinds of horses
2. Farriers
3. Types and kinds of equipment
B. Trails
C. Housing stock
D. Horse shows
E. Feeding stock

Suggested Learning Activities

1. Evaluate existing successful campground based on physical and socioeconomic factors.
2. Inventory a proposed campground site.
a. Prepare survey maps of boundaries, contours, water and vegetation features, and existing cultural developments.
b. Prepare a written report summarizing natural hazards existing on the site, recommended development of water resources, recommended campsite and sanitation facilities location, natural features of interest, recommended access to the site, recommended road layout, and suggested recreation activities that the site may be developed to accommodate.
3. With inventory data in (2) and printed material regarding campground facilities and layout specifications, prepare a workable campground site design, considering:
a. Carrying capacity of the site
b. Types of facilities included
c. Design of all roads, buildings, campsites, sanitation facilities, trails, platforms, fireplaces, rubbish disposal facilities, benches, stables, safety regulation devices, signing, and lighting
d. Design all cultural treatment of vegatation including removal of hazardous vegetation, landscaping scenic vistas, road lighting, campsite lighting, barriers, lawns, and erosion control
4. Prepare a workable plan for the maintenance of a developed campground or picnic area, including:
a. Upkeep of the facilities
b. Provision of services
c. Maintenance of roads and trails
d. Maintenance of vegetation
e. Reduction of all forms of hazards
5. Draw a riding trail area and incorporate points of interest.
6. Obtain a soil survey map and land capability map of a hunting preserve area to determine the best area to be used for hunting and the best area for fishing.

a. Construct a small scale model of the area
b. Plan for feed crops of the wildlife in the preserve

7. Use sports magazines to write for information and literature on different dude ranches and on basis of information received, select one to visit. Give reasons for selection.
8. Visit a nearby riding club.
9. Visit a fishing resort operation for observation of the types of cabins and layout of the area.
10. Survey the fishing traffic in a resort area to determine the number of boats and equipment.

References

Douglass. *Forest Recreation.*

Jensen, C. R. *Outdoor Recreation in America.*

U.S.D.A. Farmer's Home Administration. *Handbook of Outdoor Recreation Enterprises in Rural Areas.*

U.S.D.A. Forest Service. *Campgrounds for Many Tastes.*

U.S.D.H.E.W., Public Health Service. *Environmental Health Practice in Recreational Areas.*

Sections of this unit were adapted from "Campground Development and Management," No. 01.0602-01, a module of instruction prepared by Bureau of Agricultural Education, State Education Department, Albany, New York 12224.

Unit

DEVELOPMENT OF WINTER RECREATION AREAS

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Utilizing maps, regional plans, governmental law codes, labor department statistics, review of governmental and private assistance programs, recognize external factors of travel time, proximity to demand, type of demand, state and local laws and regulations, competition, financing, etc., in selecting a site for a winter recreational area.
2. Recognize internal factors of physical features of the site, presence of natural attractions, expansion area, ease of access, water supply, vegetation, etc., in selecting a site for a winter recreational area.
3. Carry out an effective inventory of a proposed recreation area through preparation of survey, maps of boundaries, contours, water and vegetation features, and existing cultural developments; prepare a written report summarizing natural hazards existing on the site, recommended development of water resources, recommended location for hills and trails, natural features of interest, recommended access to the site, recommended road layout within the area, and suggested recreation activities that the site may be developed to accommodate.
4. Demonstrate ability to develop, with inventory data and printed material relating to skiing slopes and layout specifications, a workable ski site design, considering:
   a. Carring capacity of the site
   b. Types of facilities
   c. Design of all roads, buildings, slopes, lifts, safety regulations, signs and lighting
   d. Design of all cultural treatment of vegetation including landscaping, removal of hazardous vegetation, scenic trails, and erosion control
5. Demonstrate ability to develop a workable plan for the maintenance of a developed winter recreation area including:
   a. Upkeep of all cultural facilities
   b. Provision of services
   c. Maintenance of roads, trails, and slopes
   d. Maintenance of adequate snow cover
   e. Reduction of all forms of hazards to promote safety

Unit Outline

I. Planning and Operating a Skiing Area
   A. Trails
      1. Location
      2. Marking and clearing
         a. National ski area signs
         b. International ski area signs
      3. Rest areas
   B. Lifts
      1. Rope
      2. Poma, platter, J- or T-bar
      3. Chair
      4. Gondola
   C. Skis and skiing equipment
   D. Patrolling the slopes
   F. Ski lessons
II. Planning Sled and Snowmobile Areas
   A. Trails
      1. Location
      2. Marking and clearing
      3. Comfort stations
   B. Renting equipment
      1. Snowmobiles
      2. Sleds and toboggans
      3. Snow shoes and skis
   C. Patrolling the area
III. Planning an Ice Skating Area
   A. Facilities
      1. Warming house and comfort station
      2. Skating rink
         a. Clearing the area of snow
         b. Maintaining the ice
   B. Offering lessons
   C. Renting equipment
      1. Skates
      2. Other

Suggested Learning Activities

1. Evaluate an existing winter recreation area based on physical and socioeconomic factors.
2. Prepare a workable plan for the development and operation of an ice skating area, including:
   a. Facilities
   b. Snow removal
   c. Provision of services (concessions, equipment rental, etc.)
3. Prepare a plan for the development of a skiing area, including:
   a. Types of facilities
   b. Design of all trails, buildings, comfort stations, safety regulations, signing, and lighting
4. Identify the national and international ski signs.
5. Prepare a plan for the development of a sledding and snowmobiling area. Incorporate points of interest.

References

Douglass. *Forest Recreation.*

Jensen, C. R. *Outdoor Recreation in America.*

The units of instruction which follow are basic to the preparation of individuals for entry level employment in soil conservation.

BEST COPY AVAILABLE

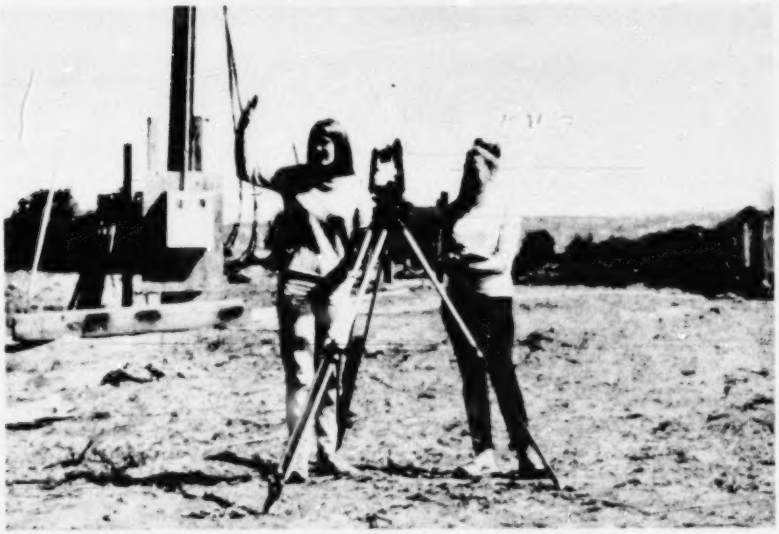

Figure 9. Soil Conservation Aides keeping field notes for survey work. Courtesy Soil Conservation Service.

Unit

SOIL MORPHOLOGY, FORMATION, AND CLASSIFICATION

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Identify five factors which affect soil formation and briefly describe the significance of each.
2. Make "feel" tests of both wet and dry soil samples and classify each in one of the U.S.D.A. classifications:
   a. Sandy soil
   b. Loamy soil
   c. Clayey soil
3. When given a soil texture triangle and the percentage of sand, loam, and clay in each sample, classify the soil texture in each sample into one of the U.S.D.A. classifications:
   a. Coarse-textured
   b. Moderately coarse-textured
   c. Medium-textured
   d. Moderately fine-textured
   e. Fine-textured
4. Classify samples of topsoil in one of three color groups:
   a. Light
   b. Medium
   c. Dark
5. With p-Hydrion papers and a color chart, determine the pH values for given samples of soil within ±0.5 units.
6. Distinguish major horizons in soil profiles and describe the major characteristics of each.
7. Classify soils in one of the permeability groups:
   a. Very slow
   b. Slow
   c. Moderate
   d. Rapid
8. Determine the moisture content of soil.
9. Recognize and describe major differences between soils as they occur in the field.

Unit Outline

I. Becoming Familiar with Soil
   A. Parent material
      1. Residual material
         a. Igneous
         b. Sedimentary
         c. Metamorphic
      2. Transplanted material
         a. Water
         b. Wind
         c. Glaciation
         d. Gravity
      3. Cumulose material
         a. Peat
         b. Muck
   B. Soil organic matter
      1. Functions
      2. Physical and chemical properties
      3. Biological properties
   C. Soil water
      1. Functions
      2. Infiltration
      3. Percolation
      4. Classification
         a. Gravitational
         b. Capillary
         c. Hygroscopic
      5. Measuring soil moisture
   D. Life in the soil
      1. Plant roots
      2. Soil mammals
      3. Earthworms
      4. Arthropods; gastropods
      5. Protoza; nematodes
      6. Microflora

II. Becoming Familiar with Soil Formation
   A. Formation of soil
      1. Parent material

2. Climate
3. Topography
4. Living organisms
5. Time

B. Physical weathering
1. Freezing - thawing
2. Heating - cooling
3. Wetting - drying
4. Erosion

C. Chemical weathering
1. Carbonation
2. Hydration
3. Hydrolysis
4. Solution
5. Oxidation

III. Determining Properties of Soil

A. Physical
1. Mechanical analysis
2. Soil separates
3. Organic material
4. Particle density
5. Bulk density
6. Soil consistency
7. Soil color

B. Chemical and colloidal
1. Soil colloids
2. Colloidal clay
3. Exchange capacity
4. Adsorption and exchange of anion and cations
5. Soil pH

C. Biological
1. Plants
2. Animal organisms
3. Organic matter

IV. Classifications of Soils and Land Uses

A. Soil classifications
1. Soil groups
a. Zonal
b. Intrazonal
c. Azonal
2. Soil series
3. Soil types
4. Soil phases
5. Soil families

B. Land-use classifications
1. Factors basic to land-use classification
a. Slope
b. Depth
c. Drainage
d. Texture
e. Permeability
f. Structure
2. Land-use classes

Suggested Learning Activities

1. Collect and identify minerals and rocks common in soil formation.
2. Make field examinations of selected sites showing the effect on soil formation of differing conditions of parent material, vegetation, living organisms, topography, and time.
3. Observe activities of soil macro-organisms in a glass-sided soil observation box.
4. Examine and describe soil profiles.
5. In a pit where the profile is exposed, examine in detail the soil horizons.
6. Analyze soil properties related to texture.
7. Ascertain organic matter and humus content of soils.
8. Analyze movement of water through soils.
9. Compare water holding capacities of soils.
10. Determine pH of several soil samples.
11. Determine soil moisture content by tensiometer.
12. Make field study of local soils.

References

Berger. *Introductory Soils.*
Buckman and Brady. *The Nature and Properties of Soil.*
Knuti and others. *Profitable Soil Management.*
U.S. Department of Agriculture. *Soil.*

Unit

SOIL CONSERVATION

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Demonstrate an understanding of soils by describing the differences among them as they occur in the field and what these differences mean insofar as limitations on use and kinds of use are concerned.
2. When observing an erosion area, recognize and identify the forms of erosion and state the probable causative agent.
3. List correctly the land use capability classes and a recommended use for each.
4. When observing a land area, identify the land classes observed and state the optimum uses for each classification. Some borderline alternate judgements will be allowed.
5. When presented with a specific land situation, identify four appropriate erosion control cover crops or structures for the particular area. Choice should be on the basis of effectiveness, cost, and maintenance.
6. Demonstrate the ability to read soil maps and to interpret the terms and symbols used on maps.
7. Interpret the elements of a conservation land use plan for a farm or other property.

Unit Outline

I. Erosion

A. Water
1. Splash
2. Rill
3. Sheet
4. Gully

B. Wind

C. Glacial

D. Physical factors influencing erosion
1. Rainfall
a. Intensity
b. Quantity
c. Seasonal distribution
2. Vegetative cover
a. Type
b. Condition
3. Nature and properties of soil
4. Slope of the land

II. Land Use Classifications

A. The land
1. Slope
2. Depth of soil
3. Internal drainage
4. Texture of surface soil
5. Stoniness
6. Organic matter content

B. Land capability classes
   1. Land classes - adapted to crops
      a. Class I - no special hazards or natural limitations
      b. Class II - some hazards or natural limitations which are easy to overcome
      c. Class III - severe hazards or natural limitations which need careful handling and management
      d. Class IV - very severe hazards or natural limitations which need very careful handling and management
   2. Land classes - for permanent vegetation only
      a. Class V - no erosion hazard but not practical to plow
      b. Class VI - moderate natural limitations
      c. Class VII - severe natural limitations
      d. Class VIII - not suitable for cropland, grassland or commercial forestry
   3. Major limiting factors considered in selecting land capability class
      a. Slope
      b. Depth of soil
      c. Internal drainage
      d. Texture of surface soil
      e. Stoniness
      f. Organic matter content
      g. Gullies
      h. Flooding

III. Land Use Recommendations
   A. Cropland
      1. Intensive cultivation
      2. Moderately intensive cultivation
      3. Moderate cultivation
   B. Grassland with occasional cultivation
      1. Occasional cultivation
      2. Minimum cultivation
   C. Grassland - permanent pasture
      1. Suitable for occasional renovation with machinery
      2. Suitable for extensive pasture only
   D. Woodland
   E. Wildlife and recreation

IV. Practices for Controlling Erosion and Sedimentation
   A. Sod-forming crops
   B. Grassed waterways
      1. Locating the waterways
      2. Determining water velocity
      3. Calculating waterway dimensions
      4. Shaping the waterways
      5. Constructing waterways
      6. Providing drainage
      7. Seeding the waterway
      8. Protecting the waterway
   C. Contour Farming
      1. Locating the contour line
      2. Contour plowing and planting
      3. Contour fencing
   D. Strip cropping
      1. Wind strip cropping, field strip cropping, buffer strip cropping
      2. Laying out contour strips
      3. Farming strip cropped fields
   E. Terraces
      1. Selecting type
         a. Channel
         b. Ridge
         c. Bench
      2. Planning the terrace system
      3. Locating and staking terrace line
      4. Constructing terraces
      5. Maintaining terraces
   F. Trees
      1. Planting shelterbelts
         a. Locating shelterbelt
         b. Selecting size and species of trees
         c. Planting trees
         d. Managing the shelterbelt
      2. Protecting trees
         a. Fencing
         b. Staking
         c. Rodent shield
   G. Other conservation practices for urban areas
      1. Sediment basins
      2. Critical area stabilization
      3. Water outlets
      4. Diversion ditches

V. Hazards in Special Uses
   A. Septic tank, disposal field
      1. Slope
      2. Depth of soil
      3. Internal drainage
      4. Stoniness
      5. Dense subsoil
      6. Flooding
      7. Groundwater contamination
   B. Housing and road building
      1. Slope
      2. Depth of soil
      3. Internal drainage
      4. Texture
      5. Stoniness
      6. Instability
      7. Flooding
   C. Pond building
      1. Slope
      2. Depth of soil
      3. Texture
      4. Stoniness
      5. Instability
      6. Rapid percolation
   D. Mapping present land use
      1. Cropland
      2. Idle land
      3. Pasture land
      4. Woodland
      5. Brushland
   E. Reading aerial and topography maps
   F. Utilizing maps

VI. Soil Surveys and Land Layout
   A. Soil survey methods
      1. Inventory of the soil - a record of physical features
      2. Land capability classes
         a. On basis of susceptibility to erosion
         b. Climate, slope, erosion effects
         c. Development of long-range plans
   B. Soil mapping units
      1. Effective depth, texture, permeability of subsoil
      2. Also included are available moisture capacity, reaction, drainage
   C. Associated land features
      1. Slope
      2. Erosion
      3. Salinity
      4. Frequency of flooding

VII. Soil Management Advisory Services Available
   A. United States Soil Conservation Service
   B. Agricultural Stabilization and Conservation Service
   C. Cooperative Extension Service
   D. State soil conservation services

Suggested Learning Activities

1. Demonstrate effect of soil conditions upon erosion.
2. Analyze and evaluate a farm soil management program.
3. Study the use of soil maps, topographic maps, and aerial photos in laying out fields, logging operations, and residential areas.
4. Examine various erosion control practices and structures on the site.
5. Study the conduct of logging operations and the relation of logging road layout to soil properties and erosion hazards.
6. Study the classes as described on the land use map and visit an area which has been mapped.
7. Prepare a chart with descriptions of each land capability class and the degree of conservation treatment needed.
8. Practice classifying land. Participate in land-judging contests.
9. Study land classes as described on a land use map.
10. Use soil survey maps and reports to determine if soils are being used according to specifications

References

Foster. *Approved Practices in Soil Conservation.*
Knuti and others. *Profitable Soil Management.*
Held and Clawson. *Soil Conservaton in Perspective.*
Soil Science Society of America and American Society of Agronomy. *Soil Survey and Land Use Planning.*
U.S. Department of Agriculture. *Soil.*

Unit

MANAGEMENT OF SOIL FERTILITY

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Collect soil samples, complete soil data forms, and submit to a laboratory for analysis.
2. Conduct laboratory test under direct supervision and make preliminary interpretations of resulting data.
3. Using samples of soil and a standard pH testing kit, test soil for acidity or alkalinity to determine the pH level, and prescribe proper additives to alter soil pH level for plant needs.
4. Make plant tissue analysis tests under direct supervision and tabulate the results in usable form.
5. Plan and carry out fertilizer trials in the greenhouse and on field plots.
6. Prescribe for a given plot and crop the proper application of manure, specifying rate, method of application, and fortification.
7. Explain the analysis data on a fertilizer tag.

Unit Outline

I. Determining Nutritional Needs of Plants
  A. Laboratory soil tests
    1. Taking soil samples
    2. Commercial testing laboratories
    3. Soil testing kits
  B. Plant tissue analysis
    1. Tests for phosphorus
    2. Tests for K
    3. Tests for N
  C. On site soil testing
  D. Fertilizer field trials

II. Maintaining and Increasing Organic Matter
  A. Grassland farming
  B. Cropland farming
  C. Carbon-nitrogen ratio
  D. Compost

III. Fertilizer Practices
  A. Commercial fertilizers
    1. Kinds and source
      a. Nitrogen
      b. Phosphate
      c. Potash
      d. Trace elements
      e. Effects upon soil
    2. Application
      a. Physical forms
      b. Method
      c. Placement
      d. Timing
      e. Trends in mechanization
      f. Effect of equipment
  B. Animal Manures
    1. Analysis
      a. Nutrients
      b. Organic matter
    2. Methods of handling
    3. Method of applying
    4. Fortification
    5. Conservation and storage
  C. Green manure and cover crops
    1. Value to soil
    2. Species and varieties
    3. Cultural operations
      a. Season of planting
      b. Limitations

IV. Liming Acidic Soils
  A. Soil Acidity
    1. pH scale
    2. Optimum pH range for common crops
    3. Causes of soil acidity
      a. Crop removal
      b. Acid forming fertilizers
  B. Correcting soil acidity
  C. Liming
    1. Need
    2. Materials
      a. Quicklime
      b. Hydrated lime
      c. Limestone
      d. Byproducts
    3. Timing
    4. Methods of application
    5. Determining amount to apply
      a. Soil acidity
      b. Buffer capacity
      c. Subsoil acidity
      d. Crops

Suggested Learning Activities

1. Conduct culture trials and fertilizer test in plots.
2. Identify the important kinds of fertilizers, their properties and uses.
3. Determine the pH of soil samples and measure their buffering capacity.
4. Test soils for solutes.
5. Test plant tissue.
6. Summarize findings of culture studies and fertilizer plots.
7. Make a field trip to observe commercial fertilizer application and local conservation practices.
8. Compare the plant nutrient requirements of a legume and a non-legume crop.

9. Compare the appearance of plants growing in inadequately limed soil with plants growing under optimum pH conditions.
10. Compare samples of living material commonly used in your area.
11. Collect samples of soil for testing.
12. Interpret soil test results.
13. Take field trip to fertilizer plant.
14. Take field trip to lime quarry.
15. Have students bring in fertilizer tag and explain analysis data.
16. Prepare a classroom demonstration showing plants growing in acid, neutral, and alkaline soil.

References

Bear. *Soils in Relation to Crop Growth.*
Donahue. *Our Soils and Their Management.*
Donahue. *Soils: An Introduction to Soils and Plant Growth.*
Knuti and others. *Profitable Soil Management.*
National Fertilizer Institute. *The Fertilizer Institute.*
Stallings. *Soil – Use and Improvement.*
Tisdale and Nelson. *Soil Fertility and Fertilizers.*
U.S. Department of Agriculture. *Soil.*

The units of instruction which follow are basic to the preparation of individuals for entry level employment in water resource management.

Figure 10. A water well inspector measuring the depth of a well.

BEST COPY AVAILABLE

Unit

WATER SUPPLY

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. List three sources of water for home and industrial use.
2. Demonstrate the ability to estimate the water needs for a given subdivision or community.
3. Describe the effects of storage on water and identify six factors which control these effects.
4. Recognize visible sources of pollution on a watershed, and prescribe measures of eradication.
5. Given the equipment and supplies and following the steps recommended by the manufacturer, conduct the sampling and analysis of water for:
   a. Microorganisms
   b. Hardness
   c. pH
   d. Chemicals
      1.) Nitrogen
      2.) Phosphorous
      3.) Iron
      4.) Sulfur

Unit Outline

I. Sources of Water
   A. Rainwater
      1. Area required; roof, other
      2. Storage required, cisterns
   B. Surface water supplies
      1. Ponds and lakes
      2. Rivers
   C. Groundwater supplies
      1. Springs
      2. Shallow wells
      3. Deep wells
      4. Artesian wells
      5. Infiltration galleries
      6. Filter crib and flooded areas

II. Demands for Water
   A. Agricultural
   B. Domestic
   C. Industrial
   D. Fire demand
   E. Demand factors
      1. Living standard
      2. Climate
      3. Quality
      4. Size of city

III. Water Storage
   A. Rainfall
      1. Amount
      2. Measurement and records
      3. Distribution
   B. Rainfall – runnoff relationship
      1. Loss coefficient
      2. Intensity
      3. Area
      4. Influence of hard surfaced areas
   C. Storage losses
      1. Evaporation
      2. Infiltration
      3. Transpiration
   D. System storage
      1. Standpipes
      2. Reservoirs

3. Elevated storage
   a. Constant head
   b. Unequal demand
   c. Fire protection

IV. Effects of Storage on Water
   A. Sedimentation
   B. Bacterial decay
   C. Organic matter decomposition
   D. Controlling factors
      1. Shape
      2. Size
      3. Depth
      4. Temperature
      5. Organic content
      6. Wind action

V. Watershed Protection
   A. Wastewater pollution
      1. Domestic
      2. Industrial
   B. Recreation
   C. Erosion

VI. Evaluating Water Quality
   A. Potability
      1. Microorganisms
      2. Taste
      3. Odor
      4. Other
   B. Chemical
      1. Calcium
      2. Magnesium
      3. Iron
      4. Manganese
      5. Sulfur
      6. Carbon dioxide
      7. Methane
   C. Physical
      1. Hardness
      2. Corrosiveness
      3. Color
   D. Manufactured pollutants
      1. Phenols
      2. Metal wastes
      3. Acids
   E. Natural pollutants
      1. Fluorides
      2. Phosphates
      3. Manganese
      4. Iron
      5. Nitrates

VII. Water Treatment
   A. Plain sedimentation
   B. Aeration
   C. Sand filter
   D. Coagulation
   E. Storage sedimentation
   F. Chlorination
   G. Softening
   H. Stabilization
   I. Fluoridation
   J. Corrosion control
   K. Algae control
   L. Taste and odor control
   M. Demineralization

Suggested Learning Activities

1. Read the home water meter at the same time daily for 30 days and determine the average daily water consumption of the family.
2. Locate the three largest users of water in the community and determine their daily water requirements.
3. Determine the average inches of rainfall in an acre area and convert it into gallons.
4. Set up a rain gauge and keep a daily record of rainfall for the duration of the module.
5. Locate the permanent rainfall checkpoints in the area and determine the rainfall distribution pattern.
6. Set up a classroom demonstration using various size containers filled with water, and observe loss through evaporation.
7. Set up a demonstration using sweet potatoes in containers of water to show loss through transpiration. (Note: the potatoes must have sunlight.)
8. Use a water pollution detection kit and determine alkalinity, ammonia, calcium, carbon dioxide, chloride, chlorine, chromium, copper, cyanide, dissolved solids, iron, magnesium, nitrates, phosphate, salinity, and sulfide content of water samples collected in the community.
9. Practice determining the hardness of fresh water samples.
10. Practice determining the pH of fresh water samples.
11. Set up a classroom demonstration of water in containers and run periodic bacterial counts.
12. Take a field trip to a watershed and locate possible pollution sources in the area. Collect samples from these sources and analyze them.
13. Collect samples of water for testing.
14. Take a field trip to a water-testing laboratory.
15. Interpret laboratory water test reports.
16. Have public health doctor speak on the importance of potable water to individual health.

References

Fair and Geyer. *Elements of Water Supply and Wastewater Disposal.*

Hardenbergh and Rodie. *Water Supply and Waste Disposal.*

U.S. Department of Health, Education, and Welfare. *Water and Wastewater Technology, A Suggested 2-Year Post High School Curriculum.*

Unit

WASTEWATER

Suggested student performance objectives

Upon completion of this unit, the student can:

1. Demonstrate the ability to estimate the volume of wastewater from a community or subdivision, given the population and industrial data.
2. Diagram a wastewater collection system for a given subdivision, complete with profile and details.
3. Outline a program for maintaining a wastewater collection system.
4. List five different methods of treating wastewater and briefly describe each.
5. Diagram a sewage disposal system for a given farm.
6. Recognize visible indications of pollution in lakes and streams, and describe probable causes.
7. List five kinds of industrial waste and briefly describe how each pollutes the waters.

Unit Outline

I. Wastewaters
   A. Sources
      1. Municipal
      2. Industrial
      3. Commercial
      4. Agricultural

5. Natural
6. Other

B. Composition
1. Physical
2. Chemical
3. Biological

C. Quantity
1. Population prediction
2. Flow pattern
3. Flow per capita
4. Infiltration
5. Industrial

II. Wastewater Collection

A. Transportation
1. Gravity flow
2. Pressure mains
3. Appurtenances

B. Designing the collection system
1. Population
2. Flow formula
3. Nomographs
4. Map construction
5. Profiles
6. Construction materials
7. Construction procedures

C. Maintaining the collection system
1. Inspecting
2. Measuring
3 Flushing and cleaning
4. Repairs
5. Taps
6. Explosions

III. Treating wastewater

A. Need for treatment
1. Protect health
2. Preserve aesthetic environment
3. Preserve recreational areas

B. Disposal without treatment
1. Dilution
2. Irrigations
3. Lagoons

C. Treatments
1. Primary treatment
   a. Screens
   b. Natural sedimentation
   c. Sludge disposal
2. Secondary treatment
   a. Biological degradation
   b. Chemicals
3. Tertiary treatment
   a. Reducing nutrients, toxic materials, pathogens, etc.
   b. Applying wastewater to land and plant cover

D. Disinfection and deodorization
1. Chlorine
2. Lime
3. Hydrogen sulfide
4. Organic compound

E. Farm sewage disposal systems
1. House sewer
2. Septic tank
3. Outlet sewer
4. Final disposal system
   a. Absorption bed
   b. Open outlet
   c. Absorption pit

IV. Effect of liquid wastes on streams and lakes

A. Zones of pollution
1. Degradation
2. Decomposition
3. Recovery

B. Methods of recovery
1. Wind action
2. Biological organisms
3. Shallow versus deep water
4. Indices of self-purification

C. Biological life of pollution
1. Worms
2. Fungi
3. Protozoa
4. Resistant forms of fish

D. Bottom deposits
1. Oxygen demand
2. Oxygen penetration
3. Rising problems

E. Industrial wastes
1. Oxygen consuming wastes
2. Colored wastes
3. Toxic wastes
4. Obstructing wastes
5. Acid wastes
6. Thermal pollution

Suggested Learning Activities

1. Have a Soil Conservation Service representative discuss sources and amounts of wastewater in the area.
2. Diagram a wastewater collection system for a subdivision, complete with profile and details.
3. Visit a sanitary sewer construction project to observe materials, equipment and methods used.
4. Draw a sketch of a liquid waste lift station for a specific flow.
5. Visit selected wastewater treatment installations in the locality. Compare the main features of each installation visited.
6. Observe streams above and below discharge points for visible effect of pollution.
7. Check effluent from a wastewater lagoon for comparison with municipal waste treatment plant.
8. Survey local industry and determine what controls have been initiated to control pollution.
9. Sketch a sewage disposal system for a farm home.

References

Fair and Geyer. *Elements of Water Supply and Wastewater Disposal.*

Hardenbergh and Rodie. *Water Supply and Waste Disposal.*

U.S. Department of Health, Education, and Welfare. *Water and Wastewater Technology. A Suggested 2-Year Post High School Curriculum.*

Unit

IRRIGATION WATER MANAGEMENT

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Define hygroscopic, capillary, and gravitational water.
2. Identify checks, dams, drops, weirs, ports, gates, spiles, and siphons.
3. List four common methods of irrigating and evaluate the feasibility of the different methods under specific conditions.
4. Design and map an irrigation system for a given set of conditions and defend the system selected.

5. Demonstrate proficiency in estimating volume of irrigation water and determining soil moisture content.
6. Define at least 16 of the 19 terms peculiar to irrigation.
7. List and explain main provisions in legal agreements used in administering and allotting irrigation water.
8. Prescribe when, how much, and how often to irrigate a specific crop under a given set of field conditions.
9. Outline procedures for draining a given field, considering:
   a. Type of drainage system
   b. Layout of drainage system
   c. Source of technical assistance
   d. Soil classification

Unit Outline

I. Establishing Water Management Systems
   A. Types of soil water
      1. Hygroscopic
      2. Capillary
      3. Gravitational
   B. Movement of water in soils
      1. Movement of water in relation to the root zone reservoir
      2. Movement of water by evaporation or transpiration
      3. Movement of gravitational water
   C. Factors involved in establishing water management systems
      1. Water source
      2. Soil types
      3. Topography
      4. Value of crops to be irrigated -- economic returns
      5. Cost of operating and maintaining systems

II. Irrigating
   A. Methods of irrigation
      1. Furrow irrigation
      2. Sprinkler irrigation
      3. Border irrigation
      4. Basin irrigation
   B. Selecting an irrigation system
      1. Gravity system
         a. Canals
         b. Laterals
         c. Ditches
      2. Pressure system
         a. Sprinkler
         b. Perforated pipe
   C. Preparing fields for irrigation
      1. Leveling and bordering
      2. Constructing head ditches
         a. Location
         b. Fall or drop
         c. Size
      3. Providing irrigation structures
         a. Types of checks, dams, drops, and weirs
         b. Kinds and sizes of ports, gates, and spiles
         c. Siphons
      4. Installing sprinkler system mains and laterals
   D. Measuring irrigation water
      1. Volume flowing from full pipe on open discharge with free fall
      2. Volume flowing from partially full pipe on open discharge with free fall
      3. Volume measurements by means of open ditch, weirs, or meters
      4. Volume discharge through pressure sprinkler systems
      5. Loss of head in open and closed systems
   E. Determining soil moisture content
      1. Hand test
      2. Dry weight test
   F. Becoming familiar with common irrigation terms
      1. Acre inches; acre feet
      2. Centrifugal pump; jet pump; submersible pump; turbine pump
      3. Consumptive use
      4. Cubic feet per second; gallons per minute
      5. Elbows; end plugs; pipe connections
      6. Dams
      7. Gates: valves; foot valve; check valve
      8. Laterals
      9. Lift
      10. Loss of head
      11. Main lines
      12. Perforated pipe
      13. Range nozzles; spreader nozzle
      14. Risers
      15. Sprinklers
      16. Sprinkler heads
      17. Total dynamic head
      18. Weirs; weir stick
      19. Well point
   G. Legal and administrative aspects
      1. Irrigation water rights
         a. Surface
         b. Ground
      2. Administering water use
         a. Private
         b. Quasi-public enterprises
         c. Public enterprises

III. Problems of Water Penetration
   A. Time period in irrigation
      1. Four-fifths zone explanation for row irrigation
      2. Uneven application by sprinkler systems
   B. Soil class in relation to water penetration
   C. Importance of head size in all irrigation plans
   D. Effect of side slopes on water penetration
   E. Effect of soil structure on water penetration

IV. Determining When, How Much, and How Often to Irrigate
   A. Class of soil
   B. Age of plant
   C. Appearance of plants
      1. Growth rate
      2. Color condition of foliage
      3. Signs of morning wilting
   D. Climate conditions
      1. Evaporation from soil
      2. Temperature and relative humidity effects on transpiration rate
   E. Transpiration rates of differing crops

V. Draining Fields
   A. Selection of method
   B. Planning and laying out system
   C. Operating drainage systems
   D. Determining cost of drainage systems
   E. Sources of technical advice
      1. Soil Conservation Service
      2. Cooperative Extension Service
      3. Agricultural Stabilization and Conservation Service
   F. Effects of proper drainage
      1. Improves aeration of soil
      2. Lessens erosion
      3. Improves granulation
      4. Reduces heaving
      5. Raises soil temperature, permits earlier seed germination
      6. Permits greater root penetration, increasing water available to crops
      7. Allows earlier use of field equipment in spring and following irrigation

Suggested Learning Activities

1. Weigh 100 grams of visibly dry soil. Place soil in kiln or oven for two hours. Re-weigh the soil to determine the

percent of capillary and hygroscopic water.

2. Place dry soil in a beaker. Place a glass tube down the inner edge of the beaker, halfway down. Add water through the glass tubing with a dropper to demonstrate upward, downward, and horizontal capillary water movement.
3. Place soil in a can with small holes in the bottom. Saturate the soil with a measured quantity of water to demonstrate gravitational water. The difference between what is added to the soil and what passes through is capillary water. The water collected is gravitational water.
4. Take a field trip to see common irrigation systems in the community. Determine the source of water, system of moving water, and system of distribution.
5. Examine commercial literature obtained from companies selling various types of irrigation equipment.
6. Interview an irrigation specialist about the costs of installing and operating an irrigation system.
7. Examine various types of sprinkler heads.
8. Using water sprinkler systems, check water distribution pattern by using cans set at equally spaced intervals from a sprinkler.
9. Take a field trip and conduct the above activity (8) with an actual field sprinkler irrigation system.
10. Using thermometers, demonstrate the differences in temperature between well-drained or waterlogged soils.
11. Practice determining when to irrigate and how much water to apply on the basis of soil moisture content and the appearance of the plants.
12. On a field trip, observe results from too frequent irrigation schedules.
13. Calculate costs and resulting monetary loss from applying 4 inches too much water to 5 acres of field crops.

References

American Association for Vocational Instructional Materials. *Planning for an Irrigation System.*

Israelsen and Hensen. *Irrigation Principles and Practices.*

U.S. Department of Agriculture. *Water.* 1955 Yearbook of Agriculture.

WILDLIFE

The units of instruction which follow are basic to the preparation of individuals for entry level employment in wildlife management.

BEST COPY AVAILABLE

Figure 11. A game farm worker preparing pheasant eggs for incubation. Courtesy Washington State Game Department.

Unit

WILDLIFE MANAGEMENT

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Recognize and describe the basic needs and relationships that exist in all wildlife.
2. Identify_____ species of birds and classify each as upland, waterfowl, birds of prey, nuisance birds, or endangered species.
3. Identify_____ species of wildlife animals and classify each as game animals, non-game animals, or endangered species.
4. Outline a plan for stimulating native and introduced game populations on a given piece of land, considering:
   a. Cover crops
   b. Food
   c. Nesting areas
5. Demonstrate the ability to develop, with printed material relating to the development and management of a hunting preserve, a workable hunting preserve design, considering:
   a. Species of wildlife
   b. Food crops
   c. Cover crops
   d. Breeding and nesting areas
   e. Water management
   f. Predator control
   g. Regulation of hunting
   h. Wildlife sanctuaries
6. List the governmental agencies concerned with wildlife conservation and the services they provide.

Unit Outline

I. Identifying Important Wildlife Species
   A. Birds
      1. Upland
      2. Waterfowl
      3. Birds of prey
      4. Nuisance birds
   B. Animals
      1. Game
      2. Furbearers
      3. Nongame

II. Managing Wildlife Populations
   A. Increasing native game populations
      1. Planting cover and food crops
      2. Nesting areas
      3. Release of game birds and animals
   B. Artificial propagation
      1. Confinement rearing
      2. Releasing birds and animals
   C. Laws and regulations
   D. Live trapping
   E. Tagging and banding
   F. Predator-prey relationship
   G. Breeding practices

III. Establishing and Managing Wildlife Preserves
- A. Laws and regulations
  - 1. Federal
  - 2. State
  - 3. County
- B. Securing site
  - 1. Leasing
  - 2. Buying
- C. Type of preserve
  - 1. Private
  - 2. State
  - 3. Federal
- D. Species of animals or birds to select
- E. Releasing game
- F. Developing food and cover
- G. Sanctuaries
  - 1. Nesting areas
  - 2. Breeding areas
  - 3. Other
- H. Water management
- I. Predator control
- J. Re-trapping birds
- K. Public relations
- L. Special needs
  - 1. Dogs
  - 2. Equipment

IV. State and Federal Agencies in Wildlife Conservation
- A. State conservation department
  - 1. Organization
  - 2. Program
- B. Federal
  - 1. Department of Interior
  - 2. Department of Agriculture
    - a. Soil Conservation Service
    - b. Farmer's Home Adminstration
    - c. Agricultural Stabilization and Conservation Service

Suggested Student Learning Activities

1. Schedule field trips to observe types of wildlife.
2. Build and stock a bird feeder.
3. Build bird house and observe birds.
4. Schedule field trip to large animal farm or zoo.
5. Have wildlife officer discuss hunting regulations.
6. Build bird traps.
7. Build animal traps.
8. Trap and release birds and animals.
9. Under supervision of wildlife officer, catch specimen, tag, and release.
10. Schedule field trip to wildlife preserve.
11. Schedule field trips to observe duties and responsibilities of wildlife personnel in natural setting.

References

Shomon and others. *Wildlife Habitat Improvement.*

Snedigar. *Our Small Native Animals, Their Hebits and Care.*

U.S.D.A. Forest Service. *Wildlife Habitat Improvement Handbook.*

Unit

GAME BIRD PROPAGATION

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Recognize and list the common species of game birds in his state, select one for propagation, and identify a source of chicks.
2. Outline a plan for hatching a given lot of game bird eggs considering light, heat, humidity, and incubation period.
3. Demonstrate the ability to develop and carry out a plan for brooding a given species of game birds considering:
   a. Floor space
   b. Temperature requirements
   c. Ventilation
   d. Lighting
   e. Waterer space
   f. Feeder space
4. List the six classes of nutrients and give a source and function of each.
5. Balance a ration for a given brood of chicks and for a given lot of growing birds.
6. List six common diseases of game birds and classify each as infectious or non-infectious.
7. Demonstrate the ability to outline and carry out a workable plan for sanitation considering:
   a. Maintenance of proper litter
   b. Disinfectants, types and uses
   c. Moisture control
8. Outline and carry out the procedure for releasing a given species of game bird, including:
   a. Age of bird
   b. Stocking rate
   c. Handling of birds
   d. Providing food and cover

Unit Outline

I. Species of Game Birds
- A. Selecting a species
  - 1. Wetland game birds
  - 2. Upland game birds
- B. Factors in selecting a species
  - 1. Source of eggs or chicks
  - 2. Market demand
  - 3. Economics involved

II. The Breeding and Reproduction of Birds
- A. Reproductive system
  - 1. Male
  - 2. Female
- B. Systems of mating
  - 1. Out breeding
  - 2. In breeding
  - 3. Cross breeding
  - 4. Line breeding
- C. Importance of the breeding program
- D. Incubation
  - 1. Light
  - 2. Heat
  - 3. Humidity

III. Brooding and Rearing Game Birds
- A. General management
  - 1. Temperature requirements
  - 2. Types of brooders
  - 3. Ventilation
  - 4. Floor space
  - 5. Water space
  - 6. Litter requirements
  - 7. Labor requirements
- B. Housing and equipment
  - 1. Types of housing
  - 2. Size of housing
  - 3. Ventilation
  - 4. Insulation
  - 5. Lighting
  - 6. Watering system
  - 7. Feeding system

IV. Feeding the Chicks and Poults
  A. Digestive system
    1. Parts
    2. Functions
  B. Principles of avian nutrition
    1. Classes of nutrients
      a. Water
      b. Carbohydrates
      c. Protein
      d. Fats
      e. Vitamins
      f. Minerals
    2. Function of nutrients
    3. Sources of nutrients
    4. Nutrient requirements
      a. Baby chicks
      b. Growing poults
    5. Ration formulation
      a. Availability
      b. Cost
      c. Nutritional value
      d. Palatability
      e. Ease of feeding
V. Controlling Diseases and Parasites
  A. Kinds of disease
    1. Infectious
      a. Contagious
        1.) Cause
        2.) Symptom
        3.) Prevention
        4.) Treatment and control
      b. Non-contagious
        1.) Cause
        2.) Symptom
        3.) Prevention
        4.) Treatment and control
    2. Non-infectious
      a. Nutritional diseases
        1.) Cause
        2.) Symptom
        3.) Prevention
        4.) Treatment
      b. Traumas
        1.) Broken bones
        2.) Bruises
        3.) Lacerations
      c. Inherited diseases and defects
  B. Kinds of parasites
    1. Internal
      a. Problem – symptom or disease caused by the parasite
      b. Prevention
      c. Treatment and control
    2. External
      a. Problem
      b. Prevention
      c. Treatment and control
  C. General sanitation
    1. Controlling moisture
    2. Disinfecting
    3. Maintaining proper litter
VI. Releasing Game Birds
  A. Age and size of bird
  B. Season
  C. Stocking rate
  D. Handling birds
  E. Providing cover
  F. Providing food crops

Suggested Learning Activities

1. Use filmstrips, charts, models, movies, and whenever possible, cages of live birds to acquaint students with the various species of game birds.
2. Draw and label the parts of the reproductive system of game birds.
3. Demonstrate the hatching of an egg in the classroom with the use of an incubator.
4. Take a field trip to a game farm to observe and study the brooding, feeding, housing, and equipment required for production.
5. Prepare a written plan for producing game birds describing the type of structure needed, type of feed required, a parasite control program.
6. Raise a crop of game birds in a school facility to obtain first hand experience in brooding, feeding, and housing game birds.
7. Draw and label the digestive system of game birds.
8. Prepare a chart listing the major nutrients, their function and utilization in game bird feeding.
9. Practice formulating balanced rations for both chicks and growing poults.
10. Invite a resource person to point out some disease symptoms in live birds and to perform a post-mortem examination.
11. Prepare a chart showing common diseases among game birds, their causes, symptoms, prevention, treatment, and control.
12. Release game birds under the supervision of wildlife officers.

References

Shomon and others. *Wildlife Habitat Improvement.*

Unit

SURVEYING WILDLIFE AND WILDLIFE COVER

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. When given the task of determining animal populations in a given area at a certain season, select an appropriate census taking technique, outline the observation routine to follow and its frequency, and describe the conditions of observation.
2. When given the task of evaluating the wildlife food and cover crops in a given area at a certain season, outline the routine to follow and describe the conditions of observation.
3. Using census data representing weekly counts of a wildlife species taken over a period of several weeks for a given area in a given season, construct the following:
   a. Frequency table
   b. Frequency polygon
   c. Histogram
4. Using wildlife census data representing weekly counts of a wildlife species taken over a period of several weeks for a given area, calculate:
   a. Mean
   b. Median
   c. Range
   d. Standard deviation

Unit Outline

I. Determining Animal Populations
  A. True census of animal population

B. Estimations of animal population
   1. Sampling
      a. Complete count on a sampling area
      b. Strip census
      c. Road census
      d. Prevalence and frequency method
   2. Indices
      a. Number of wildlife in relation to an environmental feature
      b. Number of wildlife caught
      c. Number of wildlife harvested
      d. Animal signs – evidence
         1.) Feeding
         2.) Bedding
         3.) Droppings
         4.) Tracks
         5.) Other
      e. Recapture method

C. Determining hunting and other mortality
   1. Estimating annual mortality
   2. Estimating seasonal mortality
   3. Measuring hunting kill
   4. Measuring crippling loss

II. Techniques and Equipment for Measuring Wildlife Population
   A. Optical instruments
      1. Binoculars
      2. Scopes
   B. Acoustical instruments
   C. Radio – tracking
   D. Radioisotopes
   E. Capturing and marking wild animals
      1. Capturing wild animals
         a. Baits and scents
         b. Trapping
            1.) Snares
            2.) Drugs
            3.) Box traps
            4.) Other
      2. Capturing birds
         a. Baits and scents
         b. Trapping
         c. Netting
         d. Drugs
      3. Handling wild animals
      4. Marking wild animals
         a. Coloring
         b. Ear notching
         c. Tagging

III. Collecting and Presenting Data
   A. Taking field notes
   B. Collecting data
      1. True census
      2. Estimating populations
         a. Sampling
         b. Indices
   C. Graphing data
      1. Frequency tables
      2. Frequency polygons
      3. Histograms
   D. Analyzing data
      1. Measures of central tendency
         a. Mean
         b. Median
         c. Mode
      2. Measures of variability
         a. Range
         b. Variance
         c. Standard deviation
   E. Comparing data
      1. Local surveys
      2. Regional surveys
      3. State surveys

IV. Evaluating Food and Cover Plants
   A. Evaluating cover density
      1. Photographic evaluation
      2. Visual estimation
      3. Number of stems per sample area
      4. Photoelectric equipment
   B. Evaluating the availability of food
      1. Number of stems or seeds per sample area
      2. Clipping method

Suggested Learning Activities

1. Conduct a weekly strip census or road census for a given location and species of wildlife over a period of one month.
2. Interview a wildlife officer and determine when and for which species of wildlife the census is taken in your state.
3. Interview a wildlife officer and determine how the annual hunting kill for a given species of wildlife is determined.
4. Observe a wildlife officer capture, mark, and release wildlife.
5. Under supervision of a wildlife officer catch, tag, and release a specimen of wildlife.
6. Using wildlife census data such as those obtained in activity (A), construct the following:
   a. Frequency table
   b. Frequency polygon
   c. Histogram
7. Using wildlife census data such as those obtained in activity (1), calculate:
   a. Mean
   b. Median
   c. Range
   d. Standard deviation
8. Cruise wildlife habitats and evaluate the food and cover crop conditions.

References

Mosby. *Wildlife Investigational Techniques.*

AUXILIARY AND SUPPORTING UNITS

The units of instruction which follow are an integral part of the preparation of individuals for entry level employment in natural resources.

BEST COPY AVAILABLE

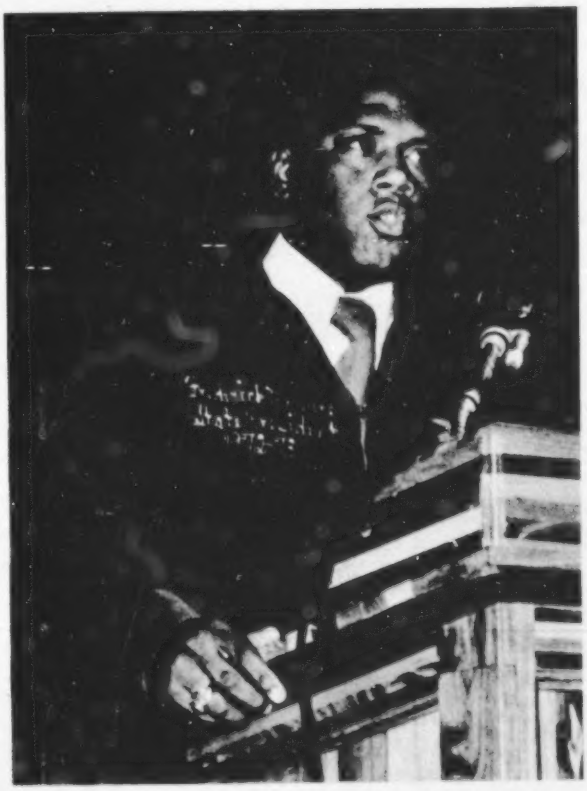

Figure 12. FFA activities encourage members to learn through actual experience how to conduct and take part in public meetings, speak in public, finance themselves, and assume civic responsibility. Courtesy National FFA.

Unit

EMPLOYABILITY SKILLS

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. List and briefly explain the main provisions in the Fair Labor Standards Act relating to minimum age, wages, and hazardous occupations.
2. Develop and write a personal resume which gives all the necessary details about his education, experience, personal qualities, and references.
3. Write a brief application letter of three or four paragraphs featuring the best qualifications of the applicant.
4. Present himself in a manner acceptable to a person conducting a job interview, using a job checklist as a guide.
5. Properly introduce fellow students, older people, and younger people to another person or to groups.
6. Effectively carry on a telephone conversation including:
   a. Initiating a telephone conversation
   b. Answering the telephone in a businesslike manner
   c. Listening to telephone conversation and formulating responses
   d. Terminating a telephone conversation
   e. Taking a telephone message and delivering it to the intended receiver
7. Handle a sales procedure effectively by going through the six basic steps in selling.
8. Exhibit a positive system of values for work by demonstrating positive relationships with peers and supervisors.

Unit Outline

I. Legal Requirements for Student Workers
   A. Labor laws
      1. Fair Labor Standards Act
         a. Minimum wage
         b. Minimum age
         c. Hazardous occupations
         d. Student learner exemptions for hazardous occupations
            1.) Conditions for exemptions
            2.) Requirements for exemptions
      2. State child labor laws
   B. Social Security
      1. Obtaining a card
      2. Withholding the tax
   C. Federal income tax
   D. Workmen's compensation
   E. Other taxes, including state

II. Job Procurement
   A. Writing letters of application
   B. Preparing personal data sheets
   C. Interviewing
   D. Other
      1. Social security number
      2. Birth certificate

III. Keeping the Job
   A. Employer – employee relations
   B. Supervisor – employee relations
      1. Treating employee as an individual
      2. Giving deserved recognition
      3. Helping without belittling

4. Understanding supervisor's duties
5. Receiving constructive criticism
   a. Listen attentively
   b. Realize job criticism
   c. Take deserved blame
   d. Ask, if in doubt

C. Employee – employee relations
1. Plan work together
2. Be considerate
3. Show cooperative attitude
4. Remain on same level
5. Treat co-workers as individuals
6. Recognize effort and achievement

D. Client – employee relations
1. Interest in customer's needs
2. Service information
3. Pleasing personality
4. Tactfulness
5. Courtesy
6. Dependability

IV. Growing On the Job
A. Developing effective work habits
1. Care and use of equipment
2. Economic use of time, material, and effort
3. Organization of work
4. Safety (home and job)
5. Punctuality, tactfulness

B. Technical improvement
1. Maintain learning attitude
2. In-service training
3. Home study
4. Post-secondary courses

C. Personal improvement
1. Plan for advancement
2. Learn how and when to speak
3. Think before you speak

D. Character training
1. Desire for improvement
2. Social consciousness
3. Usefulness

V. Improving Communication Skills
A. The basic steps in selling
1. The approach
2. Finding the customers needs and desires
3. Helping customers examine the goods and services
4. Answering customer questions and objectives
5. Completing the sale
6. Suggesting additional merchandise or service

B. Communicating via telephone
1. Initiating a telephone conversation
2. Answering telephone in a businesslike manner
3. Listening to telephone conversation and formulating responses
4. Terminating a telephone conversation
5. Taking and delivering telephone messages

C. Communicating thoughts and facts clearly by writing
1. Using technical terms
2. Importance of correct spelling
3. Importance of correct grammar

Suggested Learning Activities

1. Write a field office of the U.S. Department of Labor and request information about wage and age exemptions for students.
2. Write letters of application.
3. Fill out job application sheets.
4. Practice job interviews.
5. Practice the introduction of students and others.
6. Write letters requesting social security card and birth certificate.
7. Visit prospective employers to determine their criteria in selecting employees.
8. Invite prospective employers and personnel managers to meet with the class.
9. Research professional publications for specific job areas.
10. List advantages of becoming members of professional organizations.
11. Practice the presentation of supplies and services to customers and the six basic steps in selling.
12. Practice using courteous and businesslike conversation on the telephone.

References

Dogin, *Help Yourself to a Job.*
Richert and others, *Retailing Principles and Practices.*

Unit

SUPERVISED OCCUPATIONAL WORK EXPERIENCE PROGRAMS

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. Demonstrate familiarity with an employing company by listing the company's products, services, policies, and briefly describe the importance of a given job to the company's finished product or service.
2. Prepare and carry out a written work experience training plan.
3. Maintain accurate daily, weekly, monthly, and yearly records of earnings and hours employed.
4. Objectively evaluate his work and school performance by listing at least two areas of strength and two areas needing improvement.

Unit Outline

I. Getting Acquainted With the Supervised Occupational Work Experience Programs
A. Locating appropriate employment in the community
1. Related to students occupational aspiration
2. Adequately equipped and properly staffed with supervisory personnel

B. Becoming familiar with the employing company
1. Company's products
2. Company's services
3. Company's policies
4. Company's history
5. Company's problems
6. Company's plans
7. Company's rules and regulations
8. Importance of one's job to the finished product or service

C. Responsibilities of personnel involved
1. Student
2. Parents
3. Teachers
4. Employer

D. Work experience training plan
1. On-the-job training
2. Related instruction

E. Evaluating the student's work
1. Student's self evaluation
2. Teacher's evaluation
3. Employer's evaluation

II. Keeping Occupational Work Experience Records
   A. Importance of records
   B. Types of records and reports involved
      1. Application for training including parental approval
      2. Student data sheet
      3. Work experience agreement form written, signed
      4. Outline of duties for employee
      5. Teacher — coordinator's visitation record
      6. Weekly work experience activity report
      7. Daily, weekly, monthly record of earnings and hours employed
      8. Annual wage and time form

Suggested Learning Activities

1. Take a field trip to observe advanced students at their occupational work experience stations.
2. Interview former students on how they got started in their occupational program.
3. Prepare a list of jobs that students may be interested in doing.
4. Apply for a social security number.
5. Review older students' outlines of duties for employees and their work experience training plans.
6. Prepare a work experience training plan under the instructor's direction and in cooperation with the employer.
7. Complete daily, weekly, monthly, and annual records of earnings and hours employed.

References

Binkley and Hammonds. *Experience Programs for Learning Vocations in Agriculture.*

French-Bray. *Supervised Occupational Experience in Agriculture, Plans and Records.*

French-Bray. *Teacher's Guide for Effective Use of Supervised Occupational Experience in Agriculture, Plans and Records.*

Martin. *Developing Supervised Occupational Experience in Agriculture.*

Mason and Haines. *Cooperative Occupational Education and Work Experience in the Curriculum.*

Unit

DEVELOPING LEADERSHIP THROUGH YOUTH ORGANIZATIONS

(The Future Farmers of America, FFA; is the national organization for students in agribusiness and natural resources including: agricultural production, supplies and services, agricultural mechanics, ornamental horticulture, natural resources and environmental science, agricultural products, and forestry. This unit is based on the FFA organization. The format may be adapted for teaching about other youth organizations.)

Suggested Student Performance Objectives

Upon completion of this unit, the student can:

1. List three types of membership in the FFA.
2. List four degrees of active membership in the FFA and state the minimum qualifications for election to each.
3. List the six offices in the FFA and discuss briefly the duties and responsibilities of each officer.
4. Identify the ten major divisions of the FFA program of activities and outline steps for developing the program of activities.
5. Participate in the business meeting deliberation of the organization by properly applying the principles of parliamentary procedure including:
   a. Making a motion
   b. Amending a motion
   c. Making a motion to refer to a special committee
   d. Making a motion to table a motion
   e. Appeal from decision of the chair
   f. Making a motion to adjourn
6. Serve effectively as a committee member, including:
   a. Attending assigned committee meetings
   b. Gathering information and materials upon which to make and present judgments.
   c. Evaluating information and materials and formulating decisions
   d. Completing committee assignments and responsibilities
7. Serve effectively as a committee chairman by:
   a. Selecting time and place of meetings
   b. Informing committee members of their role and responsibilities
   c. Ensuring that the democratic process is observed
   d. Making individual member assignments
   e. Presenting findings and/or recommendations at meetings
   f. Making periodic assessment of progress
8. Serve effectively as an officer by:
   a. Fulfilling the duties of the office to which elected
   b. Delegating responsibilities
   c. Representing organization at special occasions
   d. Coordinating the work of the organization
   e. Ensuring that the democratic process is observed
   f. Being responsible for the welfare of the organization
   g. Conducting meetings using proper parliamentary procedure
   h. Planning and posting agendas in advance of regular meetings

Unit Outline

I. Understanding the Place of FFA in Agribusiness and Natural Resource Education
   A. FFA, an intracurricular activity
   B. Values of FFA membership
   C. Contribution of FFA
      1. To the school
      2. To the community
II. Becoming Acquainted With Democratic Leadership
   A. Leadership
      1. Formal leadership
      2. Informal leadership
   B. Qualities of leadership
   C. Styles of leadership
   D. Functions of democratic leadership
   E. Opportunities for developing leadership abilities
      1. Home
      2. School
      3. Community
      4. FFA
III. Becoming Acquainted with the FFA
   A. History of the FFA
   B. Primary aim of the FFA
   C. Purposes for which the FFA was organized
   D. FFA Motto
   E. FFA Colors
   F. FFA Emblem
   G. FFA Creed
   H. Governing and financing the FFA
      1. Local
      2. State
      3. National

IV. Becoming Familiar With FFA Membership and Degrees
   A. Membership
      1. Active
      2. Alumni
      3. History
   B. Membership degrees
      1. Greenhand Degree
      2. Chapter Farmer Degree
      3. State Farmer Degree
      4. American Farmer Degree

V. Planning and Conducting a Chapter Meeting
   A. Offices in FFA
      1. President
      2. Vice President
      3. Secretary
      4. Treasurer
      5. Reporter
      6. Sentinel
      7. Advisor
   B. Chapter meetings
      1. Arranging the meeting room
      2. Essentials of a chapter meeting
      3. Suggested order of business
      4. Responsibilities for chapter meetings
         a. Members
         b. Officers

VI. Getting Acquainted With Duties and Responsibilities of FFA Officers and Members
   A. FFA officers
      1. Specific duties
         a. President
         b. Vice President
         c. Secretary
         d. Treasurer
         e. Reporter
         f. Sentinel
      2. Qualifications for office
         a. Local
         b. State
         c. National
      3. General responsibilities
         a. Conducting program of activities
         b. Regular officer meetings
         c. Leadership activities for officers and members
         d. Conducting chapter meetings
   B. Responsibilities of FFA members
      1. Personal appearance
      2. Proper manners
      3. Behavior in public
      4. FFA code of ethics

VII. Developing Proficiency in Parliamentary Procedure
   A. Presiding over meetings
      1. Using the gavel
      2. Proceeding with the order of business
      3. Enforcing the rules
   B. Using parliamentary procedure tools
      1. Making a motion
      2. Amending a motion
      3. Making a motion to refer an item of business to a committee
      4. Making a motion to table a motion
      5. Appealing from the decision of the chair
      6. Making a motion to adjourn

VIII. Planning and Conducting the FFA Chapter Program of Activities
   A. Program of activities
      1. Importance of a program of activities
      2. Major divisions in a program of activities
      3. Activities
      4. Goals
      5. Ways and means
   B. Developing a program of activities
   C. Carrying out a program of activities
      1. Responsibility of the chairman
      2. Responsibility of committee members
   D. Evaluating the program of activities

IX. Improving Oneself Through Public Speaking
   A. Conversation
      1. Gaining poise and confidence
      2. Making conversation pleasing
      3. Telling a good story
   B. Making introductions
   C. Preparing a speech
      1. Selecting the subject
      2. Preparing the speech
      3. Delivering the speech
         a. Proper breathing
         b. Proper pronunciation
         c. Using good grammar

Suggested Learning Activities

1. Accept an FFA committee assignment suited to interest and ability.
2. Identify the functions and purposes of the committee.
3. Prepare written and oral committee reports.
4. Participate in discussion of how committee work contributes to the functioning of an organization.
5. Participate in classroom study and discussion of committee chairman responsibilities.
6. Observe other effective committee chairmen.
7. Serve as a committee chairman.
8. Participate in special training programs for committee chairmen.
9. Present a committee report at a regular meeting.
10. Participate in classroom study and practice of parliamentary procedure.
11. Describe recommended procedures for planning and conducting chapter meetings as stated in the official FFA manual.
12. Attend and participate in meetings.
13. Identify the characteristics of a good meeting.
14. Participate in classroom discussions, demonstrations, oral and written reports, and public speaking competition.
15. Arrange for election of officers at every class level.
16. Participate as officer.
17. Plan, conduct, and participate in leadership workshops.
18. Participate in orientation session for new officers.
19. Visit appropriate officers in community organizations.
20. Establish performance standards for local FFA officers.
21. Prepare for and participate in parliamentary procedure demonstrations.
22. Plan and post agenda in advance of regular chapter meetings.
23. Participate in leadership activities above the chapter level.
24. Participate in an agricultural class discussion on leadership.
25. Attend and observe at least four community organization meetings in addition to FFA meetings.
26. Describe what a leader does.
27. Prepare a list of leaders in a variety of positions and when possible observe them in leadership roles (national, state, school, chapter).
28. Analyze prior learning activities and list the characteristics of democratic leadership.
29. Analyze the qualities of recognized good leaders.
30. Conduct a self-evaluation, identifying the strong and weak points and building on the strong points.
31. Develop and display a knowledge of the FFA and its operation.
32. Practice making formal introductions.
33. Prepare a short talk and present in class. Use tape recorder and allow each student to hear himself on tape.

References

Bender. *The FFA and You.*

Future Farmers of America Foundation, Inc. *Awards for You.*

Future Farmers of America Foundation, Inc. *National FFA Contests.*

Future Farmers of America and Massey-Ferguson, Inc. *Advisor's Teaching Guide on FFA.*

National FFA Supply Service. *Official FFA Manual.*

Ross. *Forward FFA.*

Sturgis. *Parliamentary Procedure.*

Wall. *A More Effective FFA.*

Chapter V.

FACILITIES AND EQUIPMENT

Adequate physical facilities and equipment are necessary for an effective natural resources occupational preparation program. Such facilities and equipment should be available and ready for use before the first class of natural resources occupational education is offered. Facilities planning can only be effectively done after the programs of instruction have been developed. The instructional areas in natural resources that have emerged in recent years due to the demands for trained persons are:

Air	Range
Fish	Recreation
Forestry	Soils
Land use planning	Water
Minerals and mineral fuels	Wildlife

Rarely would a school offer courses in all of these instructional areas. Thorough planning is important in setting up a program to include the appropriate facilities and equipment for the instructional areas of natural resources which are to be included in the curriculum.

Typical facilities for a secondary school offering occupational preparation in the natural resources would include: a classroom, office space for staff, laboratories, storage facilities, and an outdoor land laboratory.

Some facilities and equipment may already exist, e.g., for agriculture, science, and industrial arts. In initiating a natural resources occupational preparation program where facilities must be constructed, the installation of multiple-use structures and areas may substantially reduce the cost of these facilities.

GENERAL PLANNING CONSIDERATIONS

When developing plans for facilities, it is well to seek the assistance of various individuals, agencies, and groups which can provide helpful ideas and suggestions. It is essential that planners are fully acquainted with local and state building codes, regulations, and standards. Information on these subjects may be obtained from sources such as state, county, or city planning commissions, state school building authorities, state vocational education staffs, school building architects, insurance companies, educational organizations, or suppliers of equipment and facilities.

DEMONSTRATION ROOM-CLASSROOM

A minimum of 35 square feet of floor space is recommended for each student in the largest class. Seats in the demonstration room-classroom should be so arranged that the view of the demonstration tables is good from both the rear and the front of the room. The room should be equipped with a demonstration table, electrical outlets, running water, gas, and shades or drapes for darkening the room during visual presentations.

A chalkboard should be along the full distance of the wall students will be facing. Adequate provision should be made for cabinets to house bulletins, books, notebooks, occupational work experience record books, natural resources magazines, and supplies.

OFFICE SPACE FOR STAFF

Office space should be provided for each instructor with no more than two staff members located in any one office. More than two staff members occupying an office tends to discourage students from approaching instructors for assistance. It is desirable to have a waiting room adjacent to staff offices where students can study comfortably while waiting for the instructor's assistance.

LABORATORIES

One or more laboratories will be needed depending on the magnitude of program initiated.

Natural Resources Science Laboratory

The natural resources science laboratory may be planned to serve as a teaching laboratory for instruction in air, forestry, range, soils, water, and some of the wildlife dissecting experiments.

The tables should include acid sinks and the table tops should be acid resistant, because most exercises involving the use of acid will be conducted in this laboratory. Each student work station should have electricity and gas, in addition to gas and electricity at the sinks in the laboratory tables along the side of the room.

Since acid may be used extensively in this laboratory, it should include a fume hood and safety equipment. An eye bath and emergency shower should be provided.

At least one cabinet in this laboratory should include chart storage for soil maps. Long flat drawers which allow the maps to be laid out flat during storage are desirable.

Portable soil bins that resemble the cabinets can be made to fit under the sinks along the side. These provide a place to store soil samples out of sight in the classroom. By having them on casters, they can be wheeled to the door for ease in filling or emptying.

Drafting Laboratory

A drafting laboratory should be located by itself, as much removed as possible from the natural resource science laboratory and classroom. This tends to avoid student traffic through the drafting room area. The drafting laboratory should be equipped with a chalkboard, corkboard, demonstration table, calculator bench, storage locker, tilting drafting tables, stools, and an instrument cabinet.

Natural Resources Mechanics Laboratory

The natural resources mechanics laboratory may be part of the agricultural mechanics laboratory if one already exists. The area should have an overhead door to provide easy access. The repair and work area must have work benches for working on and repairing the equipment. Tool storage should be enclosed and locked. Chain saws, tool sets, and surveying equipment should be stored here and handed out only during laboratory periods.

PREPARATION ROOMS

The preparation rooms can be used by students and instructors. They are located between the laboratories and classrooms, and are glassed in so that student activities may be observed by the instructor. Venetian blinds can be provided so windows can be darkened.

The preparation rooms should have sinks for cleaning glassware and other laboratory equipment. Sinks should contain commercial

garbage disposal units to dispose of plant materials from the labs.

The preparation room, off of the natural resources science laboratory, should include an area for balances. Due to the delicate characteristics of these instruments, a special base for them should be provided. Ordinary cabinets permit too much vibration to provide required accuracy in the use of the most precise balances.

A fume hood should be provided in each preparation room to insure safety in working with certain chemicals. State and local safety standards should be followed carefully.

A separate room equipped with exhaust fan should be provided for incubating eggs and hatching chicks.

STOREROOM

It is desirable to have a central storeroom as near to all laboratories as possible to reduce the distance and time required to reach the storeroom. The storeroom should be open to the outside for ease in making deliveries of supplies and equipment. It should be well lighted and have a variety of shelf and cabinet sizes.

OUTDOOR LAND LABORATORY

Depending on the magnitude of the natural resources program initiated, from 10 to 30 acres will be needed for the development of a land laboratory. The land must be reasonably level, well drained, and easily tilled. Established schools which are adding a natural resources program should acquire land if they do not have it, or work out a cooperative program with existing municipal, state, or national parks or lands.

Arboretum

A planting of the different kinds of trees, shrubs, grasses and other plants for identification purposes will be needed for certain instructional areas. From three to five plants of each species or cultivar (variety) should be planted to insure against loss of single specimens and to enable students to learn to recognize more than one specimen. Many of these specimens can be incorporated into the landscaping of the grounds in the immediate vicinity of the school building. This arboretum can be combined with a nature study and conservation area if facilities for instruction are also needed.

Forest Plantation

A forest plantation for tree identification, cruising, and cutting purposes and for demonstration of types of cutting, weed control, fertility, and cultural practices will require six to ten acres. The forest plantation can serve as a wildlife habitat if facilities for this instruction are also needed.

Demonstration Plots

Demonstration plots for experiments in soil fertility management, irrigation practices, and other purposes will require one to four acres. A gentle slope with a south, southeastern, or southwestern exposure is best. Protection from strong winds is important. Irrigation for the demonstration plots is essential.

Camping and Picnic Area

Recreation facilities for one or more recreation vehicles, a tenting area, and a picnic area can be developed near the school forest. Lightly wooded sites provide either natural or manmade shade as well as sunshine and permit rapid dryoff after heavy rains. A supply of water and a sewage system are essential. A road leading to the recreation area needs to be substantial and wide enough to carry recreation vehicles and buses. Parking facilities need to be adequate for visitors and users if school policy permits.

Pond

A pond of not less than one-quarter of an acre in surface area can provide an opportunity for "hands-on" experience in several instructional areas including fish and recreation. Ideal topography for a pond is a natural low area or broad draw with a narrow neck at its lower end, permitting runoff and spring water to be impounded with a short dam across the neck. The dam, sides, and bottom of the pond should be composed of soils that contain enough clay to provide a watertight basin when properly compacted.

The ideal watershed will supply enough water to keep the pond full at all times. The water should be free of silt and other pollution. Forest cover and grassland are the two best types of watershed cover.

SUGGESTED AUDIOVISUAL EQUIPMENT

The following equipment should be available for use:

Polaroid Land Camera	1
35mm camera and attachments	1
Tape recorder	1
16mm projector with screen	1
Overhead projector	1
Opaque projector	1
Slide projector (carousel type with remote control)	1
Screen	1

Additional audiovisual aids are likely to be available in the near future. These will expand the opportunity for use of audiovisual materials. New equipment should be added as it becomes available and practical. In the case of new construction, laboratories should be equipped for closed circuit television facilities.

The final choice of equipment should be decided by the appropriate instructors who are familiar with the equipment and needs of the program.

SUGGESTED LABORATORY EQUIPMENT

Following is a list of equipment considered necessary for the natural resources program for a class of 16 students. With very few exceptions, this equipment represents a minimum for the occupational curriculum outlined in this guide.

AIR

Orsat apparatus	1
Dustfall containers and stands	10
High volume filter sampler and shelter	2
Orifice calibration kit	1
Tape sampler	2
Rotorod assembly	2
Cascade impactor	1
Lead dioxide candle stations	5
Sulfation plate holders	5
Rubber cracking apparatus	5
Corrosion plates	10
Sampling probe, 4'	1
Sampling probe, 8'	1
Sampling nozzle, 1/4"	1
Sampling nozzle, 3/8"	1
Sampling nozzle, 1/2"	1
Fabric panels	3
Silver plates	3
Membrane filters and holders	3
Grab sampling vessels	5
Greenburg-Smith Impingers	5
Midget impingers	5
Densitometers	1
Andersen sampler	1
Ozone meter	1
24 hour sampler	1
Sequential sampler	1

FISH

Brood pond	1
Secchi Disk	3
Sein, 100', 2" mesh	1
Fish tagging pliers	2
Aerators	2
Scales	2
Wash tubs	4
Depth-o-meter	1
Stereo-microscopes	6
Plankton net	4
Hip boots	8 pair
Aquarium and accessories	2

FORESTRY

Hardhats	16
Nonpoisonous killing jars	4
Insect net	4
Insect spreading board	4
Relaxing box, insect	1
Insect exhibit case	4
Chain saws	2
Farm tractor with integral bucket and log forks	1
Biltmore sticks	3
Abney levels	3
Surveying compasses	3
Tree calipers	3
Diameter tapes	3
Log rules	16
Mistblower	1
Pruning saws	16
Paint (marking) guns	6
Tree markers	2
Tree injectors	1
Pressure spray cans	1
Brush saw	1
Woodsman's saws	4
Brush axes	4
Direct seeders	4
Planting bars	6
Planting mattocks	6
Tree increment borer	3
Fire rake	3
Fire swatter	3
Shovels	3
Back-pack pump	3

LAND USE PLANNING

Steel tapes, 100' Surveyor's	8
Acreage wheel	1
Plumb bobs, 8 oz.	8
Steel tapes, 2 chain, topographic	8
Chaining pins	8 sets
Abney levels	8
Clinometers	8
Range poles	12
Transits	2
Levels	2
Plane tables and alidades	2
Level rods	2
Stadia rods	2
Drafting tables	16
Drafting stools	16
Drawing Instruments	16
Triangles	32
Assorted curves and templates	32
Lettering guide sets	16

MINERALS AND MINERAL FUELS

Exhibit cases (petroleum products)	4
Exhibit cases (rocks and minerals)	8
Hand lenses	8
Picks	8
Spades	8

Note: Instruction and practical experience in the reclamation of mined area lands will require water sampling equipment, air-testing equipment, and soil sampling equipment which are listed under their respective instructional areas.

RANGE

Polyethylene plastic storage bags	500
Grain head and seed mounts	50
Display jars	24
Plant mounting sheets	200
Specimen labels	1,000
Seed sample display box	2
Glass sample vials	200

RECREATION

Ring buoys	4
Lifejackets	4
Boat, 14'	1
Oars	1 pair
Picnic table	1
Garbage cans	4

Note: Instruction and practical experience in the development and management of recreation enterprises may require forestry tools and equipment and measurement and surveying equipment which are listed under Forestry and Land Use Planning.

SOIL

Soil augers	6
Soil sampling spades	2
Soil test kit – Hellige-Truog	2
Set of sieves for soil analysis	1
Soil thermometer	2
Moisture meter	1
Oven	1
Balance, torsion	6
Paper soil sample bags	200
Hand lens	6

WATER

LaMotte Water Quality Student Outfits and Reagent Systems	8
Water pollution detection outfit	2
Rain and sprinkler gauge	6

WILDLIFE

Refrigerator	1
Dissecting trays	16
Dissecting kits	16
Tissue forceps	16
Thumb forceps	16
Wire mesh strainers	16
Rubber aprons	16
Demonstration incubator brooder	1
Incubator-brooder combination 100 chick	1
Muzzles	4
Small animal cages	8
Binoculars	8
Single spring traps	4
Double spring traps	4
Havahart traps	8

Appendix A

SELECTED LIST OF TEXT AND REFERENCE BOOKS

Air Pollution Control Association. *Air Pollution Experiments for Junior and Senior High School Science Classes.* Pittsburgh, PA: The Association, 1969.

American Association for Vocational Instructional Materials. *Planning for an Irrigation System.* Athens, GA: The Association, 1971.

Anderson, R.F. *Forest and Shade Tree Entomology.* New York, NY: John Wiley and Sons, Inc. 1960.

Barker, K. and others. *Air Pollution.* New York, NY: Columbia University Press, 1961.

Bear, F.E. *Soils in Relation to Crop Growth.* New York, NY: Van Nostrand Reinhold Co., 1965.

Bender, R. and others. *The FFA and You.* Danville, IL: Interstate Printers and Publishers, Inc., 1962.

Berger, K.C. *Introductory Soils.* New York, NY: MacMillan Co., 1965.

Binkley, H. and C. Hammonds. *Experience Programs for Learning Vocations in Agriculture.* Danville, IL: Interstate Printers and Publishers, Inc., 1970.

Brockman, C.F. *Recreational Use of Wild Land.* New York, NY: McGraw-Hill Book Co., Inc., current edition.

Buckman, H.O. and N.C. Brady. *The Nature and Properties of Soil.* New York, NY: MacMillan Co., 1969.

Corman, R. *Air Pollution Primer.* New, NY: National Tuberculosis and Respiratory Disease Association, 1969.

Davis, K.P. *Forest Management.* New York, NY: McGraw-Hill Book Co., Inc., 1966.

Davis, R.E. and J. Kelly. *Short Course in Surveying.* New York, NY: McGraw-Hill Book Co., current edition.

Devorkin, H. and others. *Source Testing Manual.* Los Angeles, CA: Los Angeles County Air Pollution Control District, 1965.

Dogin, Y. *Help Yourself to a Job.* Parts I, II, III. Minneapolis, MN: Finney Co., 1969.

Donahue, R.L. *Our Soils and Their Management.* Danville, IL: Interstate Printers and Publishers, Inc., 1970.

Donahue, R.L. *Soils: An Introduction to Soils and Plant Growth.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1965.

Douglass, R.W. *Forest Recreation.* New York, NY: Pergamon Press, Inc., 1969.

Ensminger, M.E. *The Stockman's Handbook.* Danville, IL: Interstate Printers and Publishers, Inc., 1962.

Executive Office of the President. Office of Management and Budget. *The U.S. Budget in Brief, Fiscal Year 1972.* Washington, DC: U.S. Government Printing Office, 1971.

Fagan, J.J. *View of the Earth – An Introduction to Geology.* New York, NY: Holt, Rinehart, and Winston, Inc., current edition.

Fair, G.M. and J.C. Geyer. *Elements of Water Supply and Wastewater Disposal.* New York, NY: John Wiley and Sons, Inc., 1958.

Fertilizer Institute. *The Fertilizer Handbook.* Washington, DC: The Fertilizer Institute, 1972.

Forbes, R.D. *Forestry Handbook.* New York, NY: Ronald Press, 1956.

Foster, A.B. *Approved Practices in Soil Conservation.* Danville, IL: Interstate Printers and Publishing, Inc., 1964.

French-Bray Printing Co. *Supervised Occupational Experience in Agriculture, Plans and Records.* Baltimore, MD: French-Bray Printing Co., 1969.

_____ *Teacher's Guide for the Effective Use of Supervised Occupational Experience in Agriculture, Plans and Records.* Baltimore, MD: French-Bray Printing Co., 1969.

Future Farmers of America and Massey-Ferguson, Inc. *Advisor's Teaching Guide on FAA.* Alexandria, VA: National FFA Supply Service, 1969.

Future Farmers of America Foundation, Inc. *Awards for You.* Washington, DC: National FFA Advisor, U.S. Office of Education, current edition.

_____ *National FFA Contest.* Washington, DC: National FFA Advisor, U.S. Office of Education current edition.

Gallant, R.A. and C.J. Schuberth. *Discovering Rocks and Minerals.* Garden City, NY: The Nature History Press, 1967.

Hardenbergh, W.A. and E.B. Rodie. *Water Supply and Waste Disposal.* Scranton, PA: International Textbook Co., 1961.

Held, R.B. and M. Clawson. *Soil Conservation in Perspective.* Baltimore, MD: Johns Hopkins Press, 1965.

Humphrey, R.R. *Range Ecology.* New York, NY: Ronald Press Co., current edition.

Israelson, O.W. and V.E. Hansen. *Irrigation Principles and Practices.* New York, NY: John Wiley and Sons, Inc., 1962.

Jensen, C.R. *Outdoor Recreation in America.* Minneapolis, MN: Burgess Publishing Co., 1970.

Knuti, L.L. and others. *Profitable Soil Management.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1970.

Lewis, R.S. and G.B. Clark. *Elements of Mining.* New York, NY: John Wiley and Sons, Inc., 1964.

Longwell, C.R. and R.F. Flint. *Introduction to Physical Geology.* New York, NY: John Wiley and Sons, Inc., 1962.

Martin, H. *Developing Supervised Occupational Experience in Agriculture.* Storrs, CT: School of Education, University of Connecticut, current edition.

Mason, R.E. and P.G. Haines. *Cooperative Occupational Education and Work Experience in the Curriculum.* Danville, IL: Interstate Printers and Publishers, Inc., 1972.

Mosbey, H.S. *Wildlife Investigational Techniques.* Washington, DC: The Wildlife Society, 1967.

Munzer, M.E. *Planning Our Town.* New York, NY: Alfred A. Knopf, 1964.

National Coal Association. *Coal.* Washington, DC: The Association, 1966.

National FFA Supply Service. *Official FFA Manual.* Alexandria, VA: National FFA Supply Service, 1972.

Pfleider, E.P. *Surface Mining.* New York, NY: The American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., 1968.

Phillips Petroleum Co. *Pasture and Range Plants.* Bartlesville, OK: Phillips Petroleum Co., current edition.

Richert, G.H. and others. *Retailing Principles and Practices.* New York, NY: McGraw-Hill Book Co., current edition.

Ross, W.A. *Forward FFA.* Alexandria, VA: Future Farmers Supply Service, current edition.

Sampson, A.W. *Range Management Principles and Practices.* New York, NY: John Wiley and Sons, Inc., current edition.

Schwab, G.O. and others. *Elementary Soil and Water Engineering.* New York, NY: John Wiley and Sons, Inc., 1965.

Shomon, J.J. and others. *Wildlife Habitat Improvement.* New York,

NY: National Audubon Society, 1966.

Smith, D.M. *The Practice of Silviculture.* New York, NY: John Wiley and Sons, Inc., current edition.

Snedigar, R. *Our Small Native Animals, Their Habits and Care.* New York, NY: Dover Publications, 1963.

Snelgrave, A.K. *Opportunities in Geology and Geological Engineering.* New York, NY: Universal Publishing and Distributing Corp., 1970.

Soil Conservation Society of America. *Planning and Zoning for Better Resource Use.* Ankeny, IA: The Society, 1971.

Soil Science Society of America and American Society of Agronomy. *Soil Surveys and Land Use Planning.* Madison, WI: The Societies, 1966.

Stallings, J.H. *Soil Use and Improvement.* Englewood Cliffs, NJ: Prentice-Hall, Inc., current edition.

Stern, A.C. *Air Pollution,* Volume I, II, III. New York, NY: Academic Press, Inc., current edition.

Stoddard, L.A. and A.D. Smith. *Range Management.* New York, NY: McGraw-Hill Book Co., current edition.

Sturgis, A.F. *Parliamentary Procedure.* New York, NY: McGraw-Hill Book Co., Inc., current edition.

Thatcher, T.C. *Forest Entomology.* Minneapolis, MN: Burgess Publishing Co., current edition.

Tisdale, S.L. and G.E. Nelson. *Soil Fertility and Fertilizers.* New York, NY: MacMillan Co., current edition.

Trier, D.S. *Forest Conservation,* Tacoma, WA; Holecombe House, 1965.

Trier, D.S. *Forest Conservation, Growing the Forest.* Tacoma, WA: Holecombe House, 1965.

U.S. Department of Agriculture. Farmer's Home Administration. *Handbook of Outdoor Recreation Enterprises in Rural Areas.* Washington, DC: U.S. Government Printing Office, 1966.

U.S. Department of Agriculture. Forest Service. Campgrounds for Many Tastes. Research Paper No. INT-6. Ogden, UT: Intermountain Forest and Range Experiment Station, 1973.

_____ *Fireman's Handbook.* Washington, DC: U.S. Government Printing Office, current edition.

_____ *Forest Recreation for Profit.* Agricultural Information Bulletin No. 265. Washington, DC: U.S. Government Printing Office, August 1962.

_____ *Introduction to the Fundamentals of Fire Behavior.* Washington, DC: U.S. Government Printing Office, current edition.

_____ *National Fire-Danger Rating System.* Washington, DC: U.S. Government Printing Office, current edition.

_____ *Wildlife Habitat Improvement Handbook.* Washington, DC: U.S. Government Printing Office, current edition.

U.S. Department of Agriculture. *How to Manage a Trout Farm.* Washington, DC: U.S. Government Printing Office, current edition.

_____. *Restoring Surface-Mined Land.* Miscellaneous Publication No. 1082. Washington, DC: U.S. Government Printing Office, 1968.

_____. *Soil.* The Yearbook of Agriculture. Washington, DC: U.S. Government Printing Office, 1957.

_____. *Water.* The Yearbook of Agriculture. Washington, DC: U.S. Government Printing Office, 1955.

U.S. Department of Health, Education, and Welfare. Office of Education. *Water and Wastewater Technology, A Suggested 2-Year Post High School Curriculum.* Washington, DC: U.S. Government Printing Office.

U.S. Department of Health, Education, and Welfare. Public Health Service. *Air Pollution Measurements of the National Air Sampling Network.* Washington, DC: U.S. Government Printing Office, current edition.

_____ *Environmental Health Practice in Recreational Areas.* Public Health Service Publication No. 1195. Washington, DC: U.S. Government Printing Office, 1966.

U.S. Department of Labor. *Manpower Report of the President.* Washington, DC: U.S. Government Printing Office, 1971.

U.S. Department of the Interior. *Construction Costs, Operational Expenses, and Methods Employed in Fish Farming,* Washington, DC: U.S. Government Printing Office, current edition.

_____. *Surface Mining and Our Environment.* Washington, DC: U.S. Government Printing Office, 1967.

Wall, S. *A More Effective FFA.* Danville, IL: Interstate Printers and Publishers, Inc., current edition.

Appendix B

SELECTED LIST OF AUDIOVISUAL AIDS

The following audiovisual materials are suggested to supplement the natural resource units of instruction. They are organized by natural resource instructional area; however, some audiovisual aids may be applicable to several areas.

Because there is considerable interest across the nation in natural resources and environmental education, the demand for these materials is enormous. When borrowing films, always give a second and third choice of show dates. Some materials may go out of print; others are being revised; some new ones are being developed. For these reasons, it is suggested that teachers, when writing to a given source, ask for a current list of resource materials.

AIR

"Air Pollution and You." Outlines basic problem of air pollution, its principal effects on health and property, some approaches to its control, and the federal program. Filmstrip, color, 46 frames, sale. Current Affairs Films, 527 Madison Avenue, NY 10022.

"Air Pollution: Take a Deep Deadly Breath." An examination of the air pollution problem, a survey of the measures that have been taken to solve the problem, and why they have failed. Film, 16mm, color, 54 minutes, sale $610, rental $40. Contemporary Films/McGraw Hill, 327 West 41st Street, New York, NY 10036.

"Answer is Clear, The." Discusses aspects of air pollution and progress made in reducing diesel exhaust smoke and odor. Film, 16mm, color, 14 minutes, free loan. Modern Talking Picture Service, Inc., 2323 New Hyde Park, New Hyde Park, NY 11040.

"First Mile Up, The." The Detroit River region and Toronto are studied to show the urgency of the problem of air pollution, and how some North American cities are fighting it. Film, 16mm, black and white, 28 minutes, sale $200, rental $14. Contemporary Films/McGraw Hill, 327 West 41st Street, New York, NY 10036.

"Poisoned Air, The." Spans the world with scenes of air pollution. City programs are shown, and the importance of citizen action is emphasized. Film, 16mm, color, 50 minutes, rental $10.50. Audio-Visual Services, 7 Willard Building, University Park, PA 16802.

FISH

"Brook Trout — Facts and Figures." Record of field research project designed to provide scientific knowledge needed to preserve brook trout population. Film, 16mm, color, 45 minutes, rental $15.70. Audio-Visual Services, 7 Willard Building, University Park, PA 16802.

"Perch Anatomy." Shows exterior structure, coloration, dissection technique, and internal structures. Film, 16mm, color, 16 minutes, rental $6.10. Audio-Visual Services, 7 Willard Building, University Park, PA 16802.

"Reservoir Fisheries of the Future." Points out the various conditions of a reservoir that must be kept at maximum natural levels including oxygen, food, light, shelter, and temperature. Film, color, 16mm. Audio-Visual Services, 7 Willard Building, University Park, PA 16802.

"Trout Hatchery." Shows stripping of eggs and sperm from adult fish by hatchery workers, resulting embryos, and emergence of young fish from eggs. Film, 16mm, color, 15 minutes, rental $6.60. Audio-Visual Services, 7 Willard Building, University Park, PA 16802.

"Trout, U.S.A." View the life of a trout both in its natural habitat and on a trout farm. Film, 16mm, color, 10 minutes, service charge, $5.***

FORESTRY

"Building the Fireline." Typical forest fire problems and tactics used to control them. Film, 16mm, color, 26 1/2 minutes, free loan. John Hall Film Service, 1923 West Atkinson Street, Milwaukee, WI 53212.

"Chain Saw Safety Pays Off." Procedures for using the chain saw. Film, 16mm, color, 27 minutes, free loan. American Pulpwood Association, 605 Third Avenue, New York, NY 10016.

"Direct Seeding of Southern Pine." This film deals with research leading to the successful direct seeding of southern timberlands. Film, 16mm, color, 20 minutes, service charge.*

"Eternal Forest, The." Presents the popular subject of man and his environment — specifically forests and woodlands. Film, color, 16mm, 21 minutes, service charge.*

"Family Forest, The." A documentary of the ceremonies honoring the first privately owned woodland in the nation to be officially designated a "Family Forest." Film, 16mm, color, 12 1/4 minutes, service charge.*

"Fire Control Simulator." Explains the use of the simulator and the various advantages of its many uses. Film, 16mm, color, 11 1/2 minutes, service charge.*

"Fire vs Fire." Instructs fire-control managers in developing abilities to know when and why fire should be used in fire control and the technical requirements of using fire in this way. Film, 16mm, color, 26 minutes, service charge.*

"Forest, The." No. C-89. A visual description of the many benefits derived from our forests through "multiple-use" management of our forest resources. 47 frames, filmstrip, $5.50**

"Forest, The." Multiple use benefits of forests. Film, 16mm, color, 28 minutes, free loan. John Hall Film Service, 1923 West Atkinson Street, Milwaukee, WI 53212.

"Introduction to Fire Behavior." This is a training film for firefighters and initial attack foreman. Film, 16mm, color, 17 minutes, service charge.*

"Rainbow Valley." Story of a forest ranger. Film, 16mm, color, 29 minutes, free loan. John Hall Film Service, 1923 Atkinson Street, Milwaukee, WI 53212.

"Tree Farm, The." Modern day methods of harvesting. Film, 16mm, color, 13½ minutes, free loan. American Forest Institute, 1835 K Street, N.W., Washington, DC 20006.

"Tree is Born, A." History and legend of Christmas trees. Film, 16mm, color, 11 minutes, free loan. John Hall Film Service, 1923 West Atkinson Street, Milwaukee, WI 53212.

"Working Forest, A." Explains the reasons for and methods of establishing a local forestry cooperative. Film, 16mm, color, 18 minutes, service charge.*

LAND USE PLANNING

"Bulldozed America." Shows some of the most serious threats to natural beauty and wilderness. Film, 16mm, black and white, 27 minutes, rental $10. National Audubon Society, 1130 5th Avenue, New York, NY 10028.

"Cities of the Future." Focuses on creative urban planning now in progress. Film, 16mm, color, 25 minutes, sale $325, rental $18. Contemporary Films/McGraw Hill, 327 West 41st Street, New York, NY 10036.

"Green City, The." Exposes the devastating destruction that occurs when trees and landscapes are irresponsibly leveled . . . and what can be done about it. Film, 16mm, color, 23 minutes, service charge, $5.***

"Multiply and Subdue The Earth." Depicts people and their utter disregard for nature through lack of awareness and indiscriminate use of the soil, water, and land. Film, 16mm, color, 2 reels, 33 1/2 minutes each, service charge, $5 per reel.***

"Urban Sprawl vs Planned Growth." Illustrates the awkward, haphazard and graceless urban development which has taken place and offers some plans for improvement. Film, 16mm, color, 21 1/2 minutes, service charge, $5.***

MINERALS AND MINERAL FUELS

"Barrel Number One." Shows the various steps involved in the discovery, production, refining, transportation, and marketing of a barrel of oil. Film, 16mm, black and white, 29 minutes, free loan. American Petroleum Institute, 1801 K Street, N.W., Washington, DC 20006.

"Coal and Water." Shows how mining practices, both surface and underground, may be modified to minimize acid drainage. Film, 16mm, color, 23 minutes, sale $200. Stuart Finley, 6926 Mansfield Road, Falls Church, VA 22041.

"Grain of Salt, A." Shows modern processing methods preparing salt for a variety of uses in the home, on farms, and in industry. Film, 16mm, color, 28 minutes, free loan. Modern Talking Picture Service, 2323 New Hyde Park Road, New Hyde Park, NY 11040.

"Greatest Good, The." Shows need for cooperation between mining and conservation. Film, 16mm, color, 28 minutes, free loan. Colorado Mining Association, 402 Majestic Building, 290 South 16th Street, Denver, CO 80202.

"Minerals." Wise use of non-renewable natural resources. Film, 16mm, color, sale $200. Encyclopaedia Britannica Educational Corporation, 425 North Michigan Avenue, Chicago, IL 60611.

"Ravaged Earth, The." Acidic soil, sulphuric rivers, and unhappy people mark the path of strip mining across Appalachia. Film, 16mm, color, 27 minutes, sale $330, rental $15. NBC Educational Enterprises, Inc., 30 Rockefeller Plaza, New York, NY 10020.

"Wide World of Petroleum." A film about people doing the hundreds of jobs required to produce petroleum energy. Film, 16mm, color, 18 minutes, free loan. American Petroleum Institute, 1801 K Street, N.W., Washington, DC 20006.

RANGE

"Grass, The Big Story," Shows how grass improves the soil and prevents erosion and floods, and many other benign effects of these grasslands. Film, 16mm, color, 29 minutes, service charge, $5.***

"Ranchers and Rangers." Story of grass and beef production through cooperative efforts of the Colorado Cattlemen's Association and public range managers. Film, 16mm, color, 18 3/4 minutes, service charge.*

"Range Allotment Analysis." Describes the systematic method used by range managers in the Forest Service to collect information on which to base their management plans and decisions for the National Forests and National Grasslands. Film, 16mm, color, 46 1/2 minutes, service charge.*

"Rangeland Research at Manitou." Shows the various experiments being conducted at the Manitou Experimental Forest, featuring the effects on land and water of different degrees of grazing – moderate, light, and heavy. Film, 16mm, color, 20 1/2 minutes, service charge.*

"Teamwork on the Nevada Range." Story of rural development through the combined efforts of Government agencies and Nevada ranchers. Film, 16mm, color, 18 minutes, service charge.*

RECREATION

"Community Lake." Working hand-in-hand with the conservation commission, a local community is shown in the construction, maintenance, and enjoyment of the many recreational facets of the lake. Film, 16mm, color, 27 minutes, service charge, $5.***

"New Opportunities in Rural Recreation." No. C-125. Describes various types of recreational projects that are being developed. 50 frames, color, mounted slides $8, filmstrip $5.50. Photography Division, Office of Information, U.S. Department of Agriculture, Washington, DC 20250.

"Rural Holidays." Rural recreation for city folks a new source of income for farmers. Film, 16mm, color, 25 minutes, service charge, $5.***

"Tent Flaps and Flapjacks." Deals with recreational opportunities in the National Forests in the North-Central states. Film, 16mm, color, 25 1/2 minutes, service charge.*

SOIL

"Beyond Tomorrow." Portrays a total coordination of the soil conservation districts and local farmers concerning the development and management of our natural resources for future use. Film, 16mm, color, 23 minutes, service charge, $5.***

"Dust is Dying, The." Shows how farmers and ranchers of the Great Plains are preparing to prevent disaster when the next, inevitable drought comes. Film, 16mm, color or black and white, 13 1/2 minutes, service charge.*

"Know Your Land." Outlines and analyzes the eight basic classes of land. Film, 16mm, color, 10 minutes, service charge, $3.***

"Know Your Land." No. C-8. This presentation shows a practical land classification method that will indicate the best land use and treatment for the various areas of a farm. 50 frames, color mounted slides $8, filmstrip $5.50.**

"Mud." Discusses how to control erosion and sedimentation during the urbanizing process. Film, 16mm, color, 20 minutes, service charge, $5.***

"New Life For The Great Plains." Promotes the Great Plains Soil Conservation Program by showing the progress made in soil and water conservation. Film, 16mm, color, 12 minutes, service charge.*

"Raindrops and Soil Erosion." The real power of raindrops is portrayed in this film. Film, 16mm, color, 21 minutes, service charge, $5.***

"Soil Conservation District, The." Explains what a district is and how it functions. Film, 16mm, color, 14 1/2 minutes, free loan. Venard Films, Box 1332, Peoria, IL 61601.

"To Save Our Land," No. C-141. Covers the work of the U.S. Soil Conservation Service from its establishment up through modern times. 48 frames, color mounted slides $8, filmstrip $5.50.**

"Washout." No. C-160. Examines the problem of urban erosion and resulting pollution of the streams and rivers and suggests some methods of controlling it. 50 frames, color mounted slides $8, filmstrip $5.50.**

"Water Everywhere – Farm Ponds." The story of how and why farmers and city people can benefit from good management of the water that falls on farmland. Film, 16mm, color, 6 minutes, service charge.*

"Water Movement In The Soil." A series of laboratory experiments, and through the use of time-lapse photography it examines the principles governing water flows. Film, 16mm, color, 25 minutes, service charge, $5.***

WATER

"How To Make a Dirty River." Take a clean river, add sewage, chemicals, heat, detergent, and people who don't care – now, how is it made clean again? Film, 16mm, color, 27 minutes, sale $330, rental $15. NBC Educational Enterprises, Inc., 30 Rockefeller Plaza, New York, NY 10020.

"Irrigating The Electric Way," No. C-38. Covers the many benefits of flood and sprinkler type irrigation and the advantages of driving the pumps by electricity. 65 frames, color mounted slides $10.50, filmstrip $7.50.**

"It's Your Decision: Clean Water." Animated figures show the basic characteristics of polluted water and how water treatment plants operate. Film, 16mm, color, 14 minutes, free loan. Associate Films, Inc., Regional Film Centers, 600 Grand Avenue, Ridgefield, NJ 07657; 561 Hillgrave Avenue, LaGrand, IL 60525; 324 Delaware Avenue, Oakmont, PA 15139.

"River Must Live, The." Introduction to water pollution and wastewater treatment. Film, 16mm, color, 21 minutes, free loan. Shell Film Library, 450 North Meridian Street, Indianapolis, IN 46204.

"This Land is Ours." Shows how land-water resources are rebuilt and strengthened as individuals and communities utilize financial and technical help through the Agricultural Conservation Program. Film, 16mm, color, 28 1/4 minutes, service charge.*

"Water." Explores the esthetic and practical use of water and encourages wiser use and reuse. Film, 16mm, color, 27 minutes, free loan. Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, NY 11040.

"Water Resourcefulness." New York State's coordinated water resources program. Film, 16mm, color, 20 minutes, sale $200, rental $15. Stuart Finley, Inc., 3428 Mansfield Road, Falls Church, VA 22041.

"Waters From The Mountain." Shows us how the snow surveyor measures water content in the snow and determines what we can expect when the snow melts. Film, 16mm, color, 20 minutes, service charge.*

"Watershed Projects For Protection and Profit." No. C-128. Describes how proper conservation practices can greatly limit the ravages of uncontrolled water and at the same time make additional water supplies available. 55 frames, color mounted slides $9, filmstrip $6.50.***

WILDLIFE

"Big Game Management on Public Lands." No. C-159. Explains where different species of wild animals are found and how most big game animals, especially deer, are making a steady increase in population through the work of conservation organizations. 79 frames, color mounted slides $12.50, filmstrip $8.50.**

"Birds of Prey." No. C-178. Discusses the role of some birds of prey in nature and describes identifying characteristics for several species. 51 frames, color mounted slides $12, filmstrip $6.50.**

"Making Plaster Casts of Animal Tracks." No. C-174. This step-by-step presentation shows what materials are needed and how they should be used to make good plaster casts of animal tracks. 29 frames, color mounted slides $11, filmstrip $5.50.**

"Patterns of The Wild." Through the eyes of a wild fox, you see that the wildlife of a forest does not merely inhabit a forest, but is a part of its structure. Film, 16mm, color, 26 minutes, service charge.*

"Sharing Our Land With Wildlife." No. C-177. Shows how soil and water conservation measures benefit wildlife on 60 percent of the land area in the United States. 58 frames, color mounted slides $12, filmstrip $6.50.**

"Some Game Birds of North America." No. C-172. Describes many of the most popular game birds in this country and gives information to help hunters and farmers attract them to hunting areas. 48 frames, color mounted slides $11, filmstrip $5.50.**

"We Share This Land." This is the story of how conservation practices bring beneficial wildlife back to the farm. Film, 16mm, color, 14 1/4 minutes, service charge.*

"Wildlife For All." No. C-175. This conservation story tells some of the benefits of having wildlife live among us. 40 frames, color mounted slides $11.50, filmstrip $5.50.**

MISCELLANEOUS

"Agricultural Science Protects Our Environment." No. C-140. Describes new ways of coping with problems developing out of increased population and industrialization. 49 frames, color mounted slides $8, filmstrip $5.50.**

"Careers in Natural Resource Management." Describes typical jobs in fish, wildlife and outdoor recreation. 53 frames, color mounted slides, sale $7.95. Vocational Education Productions, California State Polytechnic College, San Luis Obispo, CA 93401.

"Ecology and Agriculture." Multi-media kit including five full color filmstrips; illustrated filmstrip scripts; narration or recorded reel tape, or cassette; overhead transparency masters; resource manual for teacher or student; and supplemental booklets from leading conservation organizations. Vocational Education Productions, California State Polytechnic College, San Luis Obispo, CA 93401.

"FFA . . . Focus on Forty." Presents the full story of the National FFA convention including a personal appearance by President Nixon and the American Royal Livestock Show and parade. Film, 16mm, color, 25 minutes, free loan. Venard Films, Box 1332, Peoria, IL 61601.

"Applying For a Job." Highlights the problems and attitudes of young men and women on their first job interview. Dramatizes mistakes made and how to correct them. Film, 16mm, color, 11 minutes, sale $48.50, rental $7.50. National Audiovisual Center (GSA), Washington, DC 20409.

"That Job Interview." Stressing useful techniques for Vietnam Veterans to use in job interviews with prospective employers and illustrates the possible application of military training to civilian jobs. Film, 16mm, color, 16 minutes, sale $68, rental $10. National Audiovisual Center (GSA), Washington, DC 20409.

---

*U.S. Department of Agriculture film available from state film libraries. Write Motion Picture Service, Office of Information, U.S. Department of Agriculture, Washington, DC 20250 for locations of these lending libraries.

**Available from Photography Division, Office of Information, U.S. Department of Agriculture, Washington, DC 20250.

***National Association of Conservation Districts, Environmental Film Service, P.O. Box 855, League City, TX 77573.

Appendix C

SELECTED LIST OF PROFESSIONAL AND TECHNICAL SOCIETIES AND ORGANIZATIONS CONCERNED WITH NATURAL RESOURCES

A list of some professional and technical societies and associations concerned with conservation and the natural resources can be a source of useful instructional information and reference data. The compendium which follows is not a complete listing; inclusion does not imply special approval; omission does not imply disapproval of an organization. Educators and students desiring information from the organizations may address inquiries to the executive secretary at the address shown.

AIR POLLUTION CONTROL ASSOCIATION, 440 Fifth Avenue, Pittsburgh, PA 15213

AMERICAN CONGRESS ON SURVEYING AND MAPPING, 733 15th Street, N.W., Washington, DC 20005

AMERICAN FISHERIES SOCIETY, 1040 Washington Building, 15th and New York Avenues, N.W., Washington, DC 20005

AMERICAN FOREST INSTITUTE, 1835 K Street, N.W., Washington, DC 20006

AMERICAN FOREST PRODUCTS INDUSTRIES, 1816 N Street, N.W., Washington, DC 20006

THE AMERICAN FORESTRY ASSOCIATION, 1319 18th Street, N.W., Washington, DC 20036

AMERICAN GEOLOGICAL INSTITUTE, 2201 M Street, N.W., Washington, DC 20037

AMERICAN GEOPHYSICAL UNION, 2100 Pennsylvania Avenue, N.W., Washington, DC 20037

AMERICAN INSTITUTE OF PLANNERS, 917 15th Street, N.W., Washington, DC 20005

AMERICAN METEOROLOGICAL SOCIETY, 45 Beacon Street, Boston, MA 02108

AMERICAN PETROLEUM INSTITUTE, 1271 Avenue of the Americas, New York, NY 10020

AMERICAN PULPWOOD ASSOCIATION, 605 Third Avenue, New York, NY 10016

AMERICAN SOCIETY OF PHOTOGRAMMETRY, 644 Leesburg Pike, Falls Church, VA 22044

AMERICAN WATER RESOURCES ASSOCIATION, P.O. Box 434, Urbana, IL 61801

AMERICAN WATER WORKS ASSOCIATION, 2 Park Avenue, New York, NY 10016

ASSOCIATION OF INTERPRETIVE NATURALISTS, 1251 E. Broad Street, Columbus, OH 43205

CONSERVATION EDUCATION ASSOCIATION, Box 450, Madison, WI 53701

ECOLOGICAL SOCIETY OF AMERICA, Oak Ridge National Laboratory, Radiation Ecology Division, Oak Ridge, TN 37831

ENTOMOLOGICAL SOCIETY OF AMERICA, 5603 Calvert Road, College Park, MD 20740

INCINERATOR INSTITUTE OF AMERICA, 60 East 42nd Street, Suite 1914, New York, NY 10017

INSTITUTE OF ENVIRONMENTAL SCIENCES, 34 South Main Street, Mt. Prospect, IL 60057

NATIONAL ASSOCIATION OF SANITARIANS, University of Denver, Denver, CO 80203

NATIONAL COAL ASSOCIATION, Coal Building, 1130 Seventeenth Street, N.W., Washington, DC 20036

NATIONAL PARKS AND CONSERVATION ASSOCIATION, 1701 18th Street, N.W., Washington, DC 20009

NATIONAL RECREATION AND PARK ASSOCIATION, 1700 Pennsylvania Avenue, N.W., Washington, DC 20006

NATIONAL WILDLIFE FEDERATION, 1412 16th Street, N.W., Washington, DC 20036

THE SOCIETY OF AMERICAN FORESTERS, Suite 300, 1010 16th Street, N.W., Washington, DC 20036

SOCIETY FOR RANGE MANAGEMENT, 2120 South Birch Street, Denver, CO 80222

SOIL CONSERVATION SOCIETY OF AMERICA, INC., 7515 NE Ankeny Road, Ankeny, IA 50021

SOIL SCIENCE SOCIETY OF AMERICA, 677 South Segoe Road, Madison, WI 53711

WATER POLLUTION CONTROL FEDERATION, 3900 Wisconsin Avenue, Washington, DC 20016

WILDLIFE MANAGEMENT INSTITUTE, 709 Wire Building, Washington, DC 20025

THE WILDLIFE SOCIETY, Suite S-176, 3900 Wisconsin Avenue, N.W., Washington, DC 20016